11-020387

[Name of Document] PATENT APPLICATION

[Reference Number] A009900193

[Filing Date] January 28, 1999

[To] Commissioner, Patent Office

[International Patent Classification] G06F 15/00

[Title of the Invention] METHOD OF DESCRIBING OBJECT REGION DATA, METHOD OF GENERATING OBJECT REGION DATA, VIDEO DATA PROCESSING METHOD, VIDEO DATA GENERATING APPARATUS AND DATA PROCESSING APPARATUS

[Number of Claims] 17

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[Indication of Official Fee]

[Prepayment Register Number]	011567	
[Amount of Payment]	¥21,000.-	

[List of Items Submitted]

[Name of Item]	Specification	1
[Name of Item]	Drawing	1
[Name of Item]	Abstract	1
[Necessity of proof]	Necessary	

[Document] SPECIFICATION

[Title of the Invention] METHOD OF DESCRIBING OBJECT REGION DATA, METHOD OF GENERATING OBJECT REGION DATA, VIDEO DATA PROCESSING METHOD, VIDEO DATA GENERATING APPARATUS AND DATA PROCESSING APPARATUS

[What is claimed is:]

[Claim 1] A method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method comprising:

identifying a desired object region in a video according to at least either of a figure approximated to the object region or a characteristic point of the object region; approximating a trajectory obtained by arranging positions of representative points of the approximate figure or the characteristic points of the object region in a direction in which frames proceed with a predetermined function; and describing information about the object region by using the parameter of the function.

[Claim 2] A method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method comprising;

describing the object region data by using at least information capable of identifying said object, number or the time stamp of a leading frame and the frame number or the time stamp of a trailing frame of the plurality of the subject frames, information for identifying the type of the

figure of an approximate figure approximating the object region, and the parameter of a function with which a trajectory obtained by arranging position data of representative points of the approximate figure corresponding to the object region in a direction in which frames proceed has been approximated.

[Claim 3] A method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method comprising;

describing the object region data by using at least information capable of identifying said object, the frame number or the time stamp of a leading frame and the frame number or the time stamp of a trailing frame of the plurality of the subject frames, the number of approximate figures approximating the object region, information for identifying the type of the figure of an approximate figure, and the parameters of functions with which trajectories corresponding to the approximate figures and obtained by arranging position data of representative points of each approximate figure in a direction in which frames proceed have been approximated.

[Claim 4] A method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method comprising;

describing the object region data by using at least

information capable of identifying said object, the frame number of a leading frame and the frame number of a trailing frame of the plurality of the subject frames, and the parameter of a function with which a trajectory obtained by arranging position data of characteristic points of the object region in a direction in which frames proceed has been approximated.

[Claim 5] A recording medium storing object region data containing information about regions of one or more objects described by the method of describing object region data according to any one of claims 1 to 4.

[Claim 6] A recording medium storing object region data containing information about regions of one or more objects described by the method of describing object region data according to any one of claims 1 to 4 and information related to each object or information indicating a method of accessing to the related information.

[Claim 7] A recording medium storing object region data containing information about regions of one or more objects described by the method of describing object region data according to any one of claims 1 to 4 and information for identifying information related to each object, and information related to each object.

[Claim 8] The method of describing object region data according to any one of claims 1 to 4, wherein

the method comprises

describing information related to the object or

a method of accessing to the related information.

[Claim 9] A video data processing method for determining whether or not a predetermined object has been specified in a screen which is displaying a video, the method comprising:

obtaining information describing parameter of a function approximating a trajectory obtained by arranging position data of representative points of the approximate figure in a direction in which frames proceed when an arbitrary position has been specified in the screen in a case where a region of the predetermined object exists in the video; detecting the position of the representative point in the frame based on the obtained information;

detecting the position of the approximate figure in accordance with the detected position of the representative point;

determining whether or not the input position exists in the approximate figure; and

determining that the predetermined object has been specified when a determination has been made that the input position exists in the approximate figure.

[Claim 10] An video data processing method for determining whether or not a predetermined object has been specified in a screen which is displaying a video, the method comprising:

obtaining information describing parameter of a function approximating a trajectory obtained by arranging

position data of characteristic points of the object region in a direction in which frames proceed when an arbitrary position has been specified in the screen in a case where a region of the predetermined object exists in the video; detecting the positions of the characteristic points in the frame in accordance with the obtained information;

determining whether or not the distance between the input position and the detected position of the characteristic point is shorter than a reference value; and

determining that the predetermined object has been specified when a determination has been made that the distance is shorter than the reference value.

[Claim 11] The video data processing method according to claims 9 or 10, wherein

the method comprises showing information related to the predetermined object when a determination has been made that the predetermined object has been specified.

[Claim 12] A video data processing method of displaying a region in which a predetermined object exists when the predetermined object has been specified in a screen which is displaying a video, the method comprising:

obtaining information describing parameter of a function approximating a trajectory obtained by arranging position data of at least representative points of an approximate figure of the object region or characteristic points of the object region in a direction in which frames proceed when the region of the predetermined object exists

in the video;

detecting the representative point or the characteristic point in the frame in accordance with the obtained information; and

displaying information for displaying the position of the object region in the screen in a predetermined form of display in accordance with the detected representative point or the characteristic point.

[Claim 13] An object-region-data generating apparatus for generating data about described information of a region of an arbitrary object in a video over a plurality of continuous frames, the apparatus comprising:

an approximating means for approximating an object region in the video in a plurality of the subject frames by using a predetermined figure;

a detecting means for detecting, in the plural frames, coordinate values of the predetermined number of representative points identifying the predetermined figure which has been used in the approximation; and

an approximating means for approximating a trajectory of a time sequence of the coordinate values of the representative points obtained over the plurality of the continuous frames with a predetermined function,

so that information about the object region is generated by using the parameter of the function.

[Claim 14] An object-region-data generating apparatus for generating data about described information of a region

of an arbitrary object in a video over a plurality of continuous frames, the apparatus comprising:

a detecting means for detecting the coordinate values of the predetermined number of characteristic points of an object region in a video over the plurality of the subject frames, and

a approximating means for approximating a time sequential trajectory of the coordinate values of the characteristic points obtained over the plurality of the continuous frames with a predetermined function,

so that information about the object region is generated by using the parameter of the function.

[Claim 15] A data processing apparatus for performing a predetermined process when a predetermined object has been specified in a screen which is displaying a video, the apparatus comprising:

means for obtaining a parameter of a function approximating a trajectory obtained by arranging position data of representative points of an approximate figure of the object region in a direction in which frames proceed in a case where a region of a predetermined object exists in the video when an arbitrary position has been specified in the screen to detect the position of the representative point in the frame;

a detecting means for detecting the position of the approximate figure in accordance with the detected position of the representative point; and

a determining means for determining whether or not the input position exists in the approximate figure.

[Claim 16] A data processing apparatus for performing a predetermined process when a predetermined object has been specified in a screen which is displaying a video, the apparatus comprising:

means for obtaining a parameter of a function approximating a trajectory obtained by arranging position data of a characteristic point of the object region in a direction in which frames proceed in a case where the region of the predetermined object exists in the video when arbitrary position has been specified in the screen to detect the position of the characteristic point in the frame; and

a determining means for determining whether or not the distance between the input position and the detected position of the characteristic point is shorter than a reference value.

[Claim 17] A data processing apparatus for performing a predetermined process when a predetermined object has been is specified in a screen which is displaying a video, the apparatus comprising:

means for obtaining a parameter of a function approximating a trajectory obtained by arranging position data of at least a representative point of an approximate figure of the object region or a characteristic point of the object region in a direction in which frames proceed when

the region of the predetermined object exists in the video to detect the representative point or the characteristic point in the frame; and

a displaying for displaying information for indicating the position of the object region in the screen in a predetermined display form.

[Detailed Description of the invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a method of describing object such that information about an object region in a video is described, a method of converting object region data and an apparatus for converting object region data such that information about an object region in a video is generated, a data processing apparatus for representing a related information about an object in a video such as Hyper media, and an object region data processing method therefor.

[0002]

[Prior Art]

Hyper media are configured such that related information called a hyper link is given in between mediums, such as videos, sounds or texts, to permit mutual reference. When videos are mainly used, related information has been provided for each object which appears in the video. When the object is specified, related information is displayed. The foregoing structure is a representative example of the

hyper media. The object in the video is expressed by a frame number or a time stamp of the video, and information for identifying a region in the video which are recorded in video data or recorded as individual data.

[0003]

Mask images have frequently been used as means for identifying a region in a video. The mask image is a bit map image constituted by giving different pixel values between the inside portion of an identified region and the outside portion of the same. A simplest method has an arrangement that a pixel value of "1" is given to the inside portion of the region and "0" is given to the outside portion of the same. Alternatively, α values which are employed in computer graphics are sometimes employed. Since the α value is usually able to express 256 levels of gray, a portion of the levels is used. The inside portion of the specified region is expressed as 255, while the outside portion of the same is expressed as 0. The latter image is called an á map. When the regions in the image are expressed by the mask images, determination whether or not a pixel in a frame is included in the specified region can easily be made by reading the value of the pixel of the mask image and by determining whether the value is 0 or 255. The mask image has freedom with which a region can be expressed regardless of the shape of the region and even a discontinuous region can be expressed. The mask image must have pixels, the size of which is the same as the size

of the original image.

[0004]

To reduce the quantity of data of the mask image, the mask image is frequently compressed. When the mask image is a binary mask image constituted by 0 and 1, a process of a binary image can be performed. Therefore, the compression method employed in facsimile machines or the like is frequently employed. In the case of MPEG-4 in which ISO/IEC MPEG (Moving Picture Experts Group) has been standardized, an arbitrary shape coding method will be employed in which the mask image constituted by 0 and 1 and the mask image using the α value are compressed. The foregoing compression method is a method using motion compensation and capable of improving compression efficiency. On the other hand, complex compression and decoding processes are required.

[0005]

To express a region in a video, the mask image or the compressed mask image has usually been employed. However, data for identifying a region is required to permit easy and quick extraction, to be reduced in quantity and to permit easy handling.

[0006]

On the other hand, the hyper media, which are usually assumed that an operation for displaying related information of a moving object in a video is performed, have somewhat difficulty in specifying the object as distinct from handling of a still image. A user usually has difficulty in

specifying a specific portion. Therefore, it can be considered that the user usually aims, for example, a portion in the vicinity of the center of the object in a rough manner. Moreover, a portion adjacent to the object which is deviated from the object is frequently specified according to the movement of the object. Therefore, data for specifying a region is desired to be adaptable to the foregoing media. Moreover, an aiding mechanism for facilitating specification of a moving object in a video is required for the system for displaying related information of the moving object in the video.

[0007]

[Objects of the Invention]

As described above, the conventional method of expressing a desired object region in a video by using the mask image suffers from a problem in that the quantity of data cannot be reduced. The method arranged to compress the mask image raises a problem in that coding and decoding become too complicated. What is worse, directly accessing to the pixel of a predetermined frame cannot be performed, causing handling to become difficult.

[0008]

There arises another problem in that a device for permitting a user to easily instruct a moving object in a video has not been provided.

[0009]

Accordingly, it is an object of the present invention

to provide a method of describing object, an object region data converting method, and an object region data converting apparatus which are capable of describing a desired object region in a video by using a small quantity of data and facilitating generation of data and handling of the same.

[0010]

Another object of the present invention is to provide a method of describing object, an object region data converting method, an object region data processing method, an object region data converting apparatus, and a data processing apparatus with which a user is permitted to easily instruct an object in a video and determine the object.

[0011]

[Means for Achieving the Objects]

According to one aspect of the present invention, there is provided a method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method identifying a desired object region in a video according to at least either of a figure approximated to the object region or a characteristic point of the object region; approximating a trajectory obtained by arranging positions of representative points of the approximate figure or the characteristic points of the object region in a direction in which frames proceed with a predetermined function; and describing information about the object region

by using the parameter of the function.

[0012]

According to another aspect of the present invention, there is provided a method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method describing the object region data by using at least information capable of identifying said object, the frame number or the time stamp of a leading frame and the frame number or the time stamp of a trailing frame of the plurality of the subject frames, information for identifying the type of the figure of an approximate figure approximating the object region, and the parameter of a function with which a trajectory obtained by arranging position data of representative points of the approximate figure corresponding to the object region in a direction in which frames proceed has been approximated.

[0013]

According to another aspect of the present invention, there is provided a method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method describing the object region data by using at least information capable of identifying said object, the frame number or the time stamp of a leading frame and the frame number or the time stamp of a trailing frame of the plurality of the subject frames, the number of

approximate figures approximating the object region, information for identifying the type of the figure of an approximate figure and the parameters of functions with which trajectories corresponding to the approximate figures and obtained by arranging position data of representative points of each approximate figure in a direction in which frames proceed have been approximated.

[0014]

According to another aspect of the present invention, there is provided a method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method describing the object region data by using information capable of identifying said object, the frame number of a leading frame and the frame number of a trailing frame of the plurality of the subject frames, and the parameter of a function with which a trajectory obtained by arranging position data of characteristic points of the object region in a direction in which frames proceed has been approximated.

[0015]

According to another aspect of the present invention, there is provided a recording medium storing object region data containing information about regions of one or more objects described by the method of describing object region data according to one of the above methods.

[0016]

According to another aspect of the present invention, there is provided a recording medium storing object region data containing information about regions of one or more objects described by the method of describing object region data according to one of the above methods and information related to each object or information indicating a method of accessing to the related information.

[0017]

According to another aspect of the present invention, there is provided a recording medium storing object region data containing information about regions of one or more objects described by the method of describing object region data according to one of the above methods and information for identifying information related to each object, and information related to each object.

[0018]

It is desirable to describe information related to the object or a method of accessing to the related information.

[0019]

According to another aspect of the present invention, there is provided a video data processing method for determining whether or not a predetermined object has been specified in a screen which is displaying a video, the method obtaining information describing parameter of a function approximating a trajectory obtained by arranging position data of representative points of the approximate

figure in a direction in which frames proceed when an arbitrary position has been specified in the screen in a case where a region of the predetermined object exists in the video; detecting the position of the representative point in the frame based on the obtained information; detecting the position of the approximate figure in accordance with the detected position of the representative point; determining whether or not the input position exists in the approximate figure; and determining that the predetermined object has been specified when a determination has been made that the input position exists in the approximate figure.

[0020]

According to another aspect of the present invention, there is provided a video data processing method for determining whether or not a predetermined object has been specified in a screen which is displaying a video, the method obtaining information describing parameter of a function approximating a trajectory obtained by arranging position data of characteristic points of the object region in a direction in which frames proceed when an arbitrary position has been specified in the screen in a case where a region of the predetermined object exists in the video; detecting the positions of the characteristic points in the frame in accordance with the obtained information; determining whether or not the distance between the input position and the detected position of the characteristic

point is shorter than a reference value; and determining that the predetermined object has been specified when a determination has been made that the distance is shorter than the reference value.

[0021]

When a determination has been made that the predetermined object has been specified, it is desirable to show information related to the predetermined object.

[0022]

According to another aspect of the present invention, there is provided a video data processing method of displaying a region in which a predetermined object exists when the predetermined object has been specified in a screen which is displaying a video, the video processing method obtaining information describing parameter of a function approximating a trajectory obtained by arranging position data of at least representative points of an approximate figure of the object region or characteristic points of the object region in a direction in which frames proceed when the region of the predetermined object exists in the video; detecting the representative point or the characteristic point in the frame in accordance with the obtained information; and displaying information for displaying the position of the object region in the screen in a predetermined form of display in accordance with the detected representative point or the characteristic point.

[0023]

According to another aspect of the present invention, there is provided an object-region-data generating apparatus for generating data about described information of a region of an arbitrary object in a video over a plurality of continuous frames, the object-region-data generating apparatus comprising an approximating means for approximating an object region in the video in a plurality of the subject frames by using a predetermined figure; a detecting means for detecting, in the plural frames, coordinate values of the predetermined number of representative points identifying the predetermined figure which has been used in the approximation; and an approximating means for approximating a trajectory of a time sequence of the coordinate values of the representative points obtained over the plurality of the continuous frames with a predetermined function, so that information about the object region is generated by using the parameter of the function.

[0024]

According to another aspect of the present invention, there is provided an object-region-data generating apparatus for generating data about described information of a region of an arbitrary object in a video over a plurality of continuous frames, the object-region-data generating apparatus comprising a detecting means for detecting the coordinate values of the predetermined number of

characteristic points of an object region in a video over the plurality of the subject frames, and an approximating means for approximating a time sequential trajectory of the coordinate values of the characteristic points obtained over the plurality of the continuous frames with a predetermined function, wherein the parameter of the function is used to generate information about the object region.

[0025]

According to another aspect of the present invention, there is provided a data processing apparatus for performing a predetermined process when a predetermined object has been specified in a screen which is displaying a video, the apparatus comprising means for obtaining a parameter of a function approximating a trajectory obtained by arranging position data of representative points of an approximate figure of the object region in a direction in which frames proceed in a case where a region of a predetermined object exists in the video when an arbitrary position has been specified in the screen to detect the position of the representative point in the frame; a detecting means for detecting the position of the approximate figure in accordance with the detected position of the representative point; and a determining means for determining whether or not the input position exists in the approximate figure.

[0026]

According to another aspect of the present invention, there is provided a data processing apparatus for performing

a predetermined process when a predetermined object has been specified in a screen which is displaying a video, the data processing apparatus comprising means for obtaining a parameter of a function approximating a trajectory obtained by arranging position data of a characteristic point of the object region in a direction in which frames proceed in a case where the region of the predetermined object exists in the video when arbitrary position has been specified in the screen to detect the position of the characteristic point in the frame; and a determining means for determining whether or not the distance between the input position and the detected position of the characteristic point is shorter than a reference value.

[0027]

According to another aspect of the present invention, there is provided a data processing apparatus for performing a predetermined process when a predetermined object has been is specified in a screen which is displaying a video, the data processing apparatus comprising means for obtaining a parameter of a function approximating a trajectory obtained by arranging position data of at least a representative point of an approximate figure of the object region or a characteristic point of the object region in a direction in which frames proceed when the region of the predetermined object exists in the video to detect the representative point or the characteristic point in the frame; and a displaying means for displaying information for

indicating the position of the object region in the screen in a predetermined display form.

[0028]

Note that the present invention relating to the apparatus may be employed as the method and the present invention relating to the method may be employed as the apparatus.

[0029]

The present invention relating to the apparatus and the method may be employed as a recording medium which stores a program for causing a computer to perform the procedure according to the present invention (or causing the computer to serve as means corresponding to the present invention or causing the computer to realize the function corresponding to the present invention) and which can be read by the computer.

[0030]

The present invention is configured such that the object region in a video over a plurality of frames is described as a parameter of a function approximating a trajectory obtained by arranging position data of representative points of an approximate figure of the object region or a characteristic point of the object region in a direction in which frames proceed. Therefore, the object region in the video over the plural frames can be described with a small quantity of the function parameters. Hence it follows that the quantity of data required to identify the

object region can effectively be reduced. Moreover, handling can be facilitated. Moreover, extraction of a representative point or a characteristic point from the approximate figure or generation of the parameter of the approximate curve can easily be performed. Moreover, generation of an approximate figure from the parameter of the approximate curve can easily be performed.

[0031]

When the representative point of the approximate figure is employed, a fundamental figure, for example, one or more ellipses, are employed such that each ellipse is represented by two focal points and another point. Thus, whether or not arbitrary coordinates specified by a user exist in the object region (the approximate figure) can be determined by using a simple discriminant. Hence it follows that the user is able to easily instruct a moving object in a video.

[0032]

When the characteristic point is employed, whether or not the arbitrary coordinates specified by a user indicates the object region can considerably easily be determined. Thus, a moving object in a video can easily be specified by the user.

[0033]

When display of an object region among regions of objects which can be identified by using object region data and which has related information, or display of an image indicating the object region is controlled, the

user is permitted to quickly recognize whether or not related information exists and the position of the object region. Therefore, the operation which is performed by the user can effectively be aided.

[0034]

[Embodiments of the Invention]

Embodiments according to the present invention will now be described with reference to the accompanying drawings.

[0035]

(First Embodiment)

FIG. 1 shows the structure of a first embodiment of the present invention. As shown in FIG. 1, an object-region-data generating apparatus comprises a video data storage portion 100, a region extracting portion 101, a portion for approximating region with a figure 102, a figure-representative-point extracting portion 103, a portion for approximating representative point to a trajectory curve 104, a related information storage portion 105 and a region data storage portion 106. A case will now be described in which the process according to this embodiment (in particular, processes arranged to be performed by the region extracting portion 101 or the region figure approximating portion 102) is configured such that the operation which is performed by a user is permitted. In the foregoing case, the GUI (not shown in FIG. 1) is employed with which video data is displayed in, for example, frame units to permit input of an instruction from the user.

[0036]

The video data storage portion 100 stores video data and comprises, for example, a hard disk, an optical disk or a semiconductor memory.

[0037]

The region extracting portion 101 extracts a portion of regions of video data. The portion of the regions are regions of an object, such as a specific person, a vehicle or a building (as an alternative to this, a portion of the object, for example, the head of a person, the bonnet of a vehicle or the front door of a building) in the video. Usually a video has the same object in the continuous frames thereof. The region corresponding to the same object frequently changes owing to the movement of the object or shaking of a camera during an image pick-up operation.

[0038]

The region extracting portion 101 extracts an object region in each frame corresponding to the movement or deformation of the object of interest. Specifically, the extraction is performed by a method of manually specifying a region in each of all of the frames. Another method may be employed with which the contour of an object is continuously extracted by using an active contour model called "Snakes" as disclosed in "Snakes: Active contour models" (International Journal of Computer Vision, vol. 1, No. 4, pp. 321-331, July, 1988 disclosed by M. Kass et al.). Also a method disclosed in "Method of tracing high-speed

mobile object for producing hyper media contents by using robust estimation" (CVIM 113-1, 1998, technical report of Information Processing Society of Japan) may be employed. According to the disclosure, deformation and movement of the overall body of an object are estimated in accordance with a position to which a partial object region has been moved and which has been detected by performing block matching. Alternatively, a method of identifying a region having similar colors by performing growing and division of a region as disclosed in Image Analysis Handbook (Chapter-2, Section II, Publish Conference of Tokyo University, 1991) may be employed.

[0039]

The portion for approximating region with a figure (hereinafter called a "region figure approximating portion") 102 approximates an object region in a video extracted by the region extracting portion 101 with a predetermined figure. The figure may be an arbitrary figure, such as a rectangle, a circle, an ellipse or a polygon. Also a method of approximating a region may be a method of performing approximation to a figure circumscribing the region. Another method of performing approximation to a figure inscribing the region may be employed or a method may be employed which is arranged such that the centroid of the region is employed as the centroid of the approximate figure. Another method of making the area ratio of the region and the approximate figure to be the same may be

employed. As an alternative to the approximation of the object region with a predetermined type figure, the type of the figure may be specified by a user for each object to which approximation is performed. Another method may be employed with which the type of the figure is automatically selected in accordance with the shape of the object or the like for each of the object to which approximation is performed.

[0040]

The approximation of the region with the figure is performed for each frame whenever a result of extraction performed by the region extracting portion 101 is input. Alternatively, approximation with a figure may be performed by using a result of extraction of a plurality of preceding and following frames. When the result of extraction of the plural frame is employed, change in the size and position of the approximate figure is smoothed among the plural frames so that the movement and deformation of the approximate figure are smoothed or an error in the extraction of the region is made to be inconspicuous. Note that the size of the approximate figure may vary among the frames.

[0041]

The figure-representative-point extracting portion 103 extracts representative points of the approximate figure which is an output of the region figure approximating portion 102. The point which is employed as the representative point varies according to the type of the

employed approximate figure. When the approximate figure is formed into, for example, rectangle, the four or three vertices of the rectangle may be the representative points. When the approximate figure is formed into a circle, the representative points may be the center and one point on the circumference or two end points of the diameter. When the approximate figure is an ellipse, the representative points may be the vertex of a circumscribed rectangle of the ellipse or the two focal points and one point on the ellipse. When an arbitrary closed polygon is the approximate figure, the vertices may be the representative points of the figure.

[0042]

The representative points are extracted in frame units whenever information about the approximate figure for one frame is output from the region figure approximating portion 102. Each representative point is expressed by the coordinate axis in the horizontal X direction and the coordinate axis in the vertical Y direction.

[0043]

The portion for approximating representative point to a trajectory curve (hereinafter called a "representative point trajectory curve approximating portion") 104 time-sequentially approximates the sequence of the representative points extracted by the figure-representative-point extracting portion 103 to a curve. The approximate curve is, for each of the X coordinate and Y coordinate of each representative point, expressed as a function of the frame

number f or time stamp t given to the video. The approximation with the curve may be approximation with a straight line or approximation with a spline curve.

[0044]

The related information storage portion 105 stores information (as an alternative to this, information about the address at which related information stored in another storage apparatus, for example, Internet or a server on a LAN) relating to the object which appears in video data stored in the video data storage portion 100. Related information may be a character, voice, a still image, a moving image or their combination. Alternatively, related information may be data describing the operation of a program or a computer. Similarly to the video data storage portion 100, the related information storage portion 105 comprises a hard disk, an optical disk or a semiconductor memory.

[0045]

The region data storage portion 106 is a storage medium in which object region data is stored which includes data for expressing a formula of the curve approximating the time-sequential trajectory of the representative points which is the output of the representative point trajectory curve approximating portion 104. When related information about the object corresponding to the region expressed by a function has been stored in the related information storage portion 105, object region data may include related

information and the address at which related information has been recorded. When information of the address of recorded related information has been stored in the related information storage portion 105, also address information may be recorded. Similarly to the video data storage portion 100 and the related information storage portion 105, the region data storage portion 106 comprises a hard disk, an optical disk or a semiconductor memory.

[0046]

The video data storage portion 100, the related information storage portion 105 and the region data storage portion 106 may be constituted by individual pieces of storage apparatus. Alternatively, the overall portion or a portion may be constituted by one storage apparatus.

[0047]

The object-region-data generating apparatus may be realized by a software which is operated on a computer.

[0048]

The operation of the object-region-data generating apparatus will specifically be described.

[0049]

FIG. 2 shows diagrams more specifically showing a sequential process. The sequential process includes a process which is performed by the region extracting portion 101 to extract the object region. Moreover, a process which is performed by the region figure approximating portion 102 to approximate the region and

a process which is performed by the figure-representative-point extracting portion 103 to extract a representative point of a figure are included. Also a process which is performed by the representative point trajectory curve approximating portion 104 to approximate the representative point trajectory with a curve is included.

[0050]

In FIG. 2, the region figure approximating portion 102 employs a method of approximating the region with an ellipse. The figure-representative-point extracting portion 103 employs a method of extracting the two focal points of the ellipse and one point on the ellipse. The representative point trajectory curve approximating portion 104 employs a method of approximating the sequence of the representative points with a spline function.

[0051]

Referring to FIG. 2(a), reference numeral 200 represents a video of one frame which is to be processed.

[0052]

Reference numeral 201 represents the object region which is to be extracted. A process for extracting the object region 201 is performed by the region extracting portion 101.

[0053]

Reference numeral 202 represents an ellipse which is a result of approximation of the object region 201 with an ellipse. A process for obtaining the ellipse 202 from

the object region 201 is performed by the region figure approximating portion 102.

[0054]

FIG. 3 shows an example of the method of obtaining an approximate ellipse when the object region is expressed by a parallelogram. Points A, B, C and D shown in FIG. 3 are vertices of the parallelogram which is the object region. In the foregoing case, calculations are performed so that which side AB or side BC is a longer side is determined. Then, a smallest rectangle having portions of its sides which are the longer side and its opposite side is determined. In the case shown in FIG. 3, a rectangle having four points A, B', C and D' is the smallest rectangle. The approximate ellipse is a circumscribing ellipse similar to the ellipse inscribing the rectangle and passing the points A, B', C and D'.

[0055]

Referring to FIG. 2(b), reference numerals 203 represent representative points of a figure expressing an ellipse. Specifically, the representative points are two focal points of the ellipse and one point on the same. The focal points of the ellipse can easily be determined from points on the two axes or a circumscribing rectangle of the ellipse. An example will now be described with which focal points F and G are determined from two points P_0 and P_1 on the major axis and point H on the minor axis shown FIG. 4.

[0056]

Initially, a and b which are parameters of the major axis and the minor axis, center C of the ellipse and eccentricity e are determined as follows:

$$E(P_0, P_1) = 2 \times a$$

$$C = (P_0 + P_1)/2$$

$$E(C, H) = b$$

$$e = (1/a) \times \sqrt{(a \times a - b \times b)}$$

where E (P, Q) is the Euclidean distance between the point P and the point Q.

[0057]

In accordance with the determined parameters, the focal points F and G can be determined as follows:

$$F = C + e \times (P_0 - C)$$

$$G = C + e \times (P_0 - C)$$

[0058]

The foregoing process for extracting the representative points from the ellipse is performed by the figure-representative-point extracting portion 103.

[0059]

The representative points extracted by the foregoing process are usually varied in the position among the successive frames owing to movement of the object of interest in the video or shaking of the image pick-up camera. Therefore, the corresponding representative points of the ellipses are time-sequentially arranged to perform approximation with a spline function for each of the X and Y

axes. In this embodiment, each of the three points F, G and H (see FIG. 4) which are the representative points of the ellipse requires a spline function for the X and Y coordinates. Therefore, six spline functions are produced.

[0060]

The approximation to a curve with spline functions is performed by the representative point trajectory curve approximating portion 104.

[0061]

The process which is performed by the representative point trajectory curve approximating portion 104 may be carried out whenever the coordinates of the representative points of each frame relating to the object region are obtained. For example, the approximation is performed whenever the coordinates of the representative points in each frame are obtained. Moreover, an approximation error is obtained to arbitrarily divide the approximation region in such a manner that the approximation error satisfies a predetermined range. Another method may be employed with which the process is performed after the coordinates of the representative points in all of the frames relating to the object region have been obtained.

[0062]

Reference numeral 204 shown in FIG. 2(c) represents the approximated spline function expressed three-dimensionally. Reference numeral 205 shown in FIG. 2(d) represents an example of the spline function which is the output of the

representative point trajectory curve approximating portion 104 (only one axis of coordinate of one representative point is shown). In this example, the approximation region is divided into two sections (the number of knots is two) which are t = 0 to 5 and t = 5 to 16.

[0063]

The thus-obtained spline functions are recorded in the region data storage portion 106 in a predetermined data format.

[0064]

As described above, this embodiment enables the object region in a video to be described as the parameter of a curve approximating a time-sequential trajectory (a trajectory of the coordinates of the representative points having the variable are the frame numbers or the time stamps) of the representative points of the approximate figure of the region.

[0065]

According to this embodiment, the object region in a video can be expressed by only the parameters of the function. Therefore, object region data, the quantity of which is small and which can easily be handled, can be produced. Also extraction of representative points from the approximate figure and producing of parameters of the approximate curve can easily be performed. Moreover, producing of an approximate figure from the parameters of the approximate curve can easily be performed.

[0066]

A method may be employed with which a basic figure, for example, one or more ellipses are employed as the approximate figures and each ellipse is represented by two focal points and another point. In the foregoing case, whether or not arbitrary coordinates specified by a user exist in the region (the approximate figure) of the object (whether or not the object region has been specified) can be determined by a simple determinant. Thus, specification of a moving object in a video can furthermore easily be performed by the user.

[0067]

The data format of object region data which is stored in the region data storage portion 106 will now be described. A case will now be described in which the representative points are approximated with a spline function. As a matter of course, a case in which the representative points are approximated with another function is performed similarly.

[0068]

FIG. 5 shows an example of the data format of object region data for recording the spline function indicating the object region in a video and information related to the object.

[0069]

ID number 400 is an identification number which is given to each object.

[0070]

A leading frame number 401 and a trailing frame number 402 are leading and trailing frame numbers for defining existence of the object having the foregoing ID number. Specifically, the numbers 401 and 402 are the frame number at which the object appears in the video and the frame number at which the object disappears. The frame numbers are not required to be the frame numbers at which the object actually appears and disappears in the video. For example, an arbitrary frame number after the appearance of the object in the video may be the leading frame number. An arbitrary frame number which follows the leading frame number and which precedes the frame of disappearance of the object in the video may be the trailing frame number. The leading/trailing time stamp may be substituted for the lading/trailing frame number.

[0071]

A pointer (hereinafter called a "related information pointer") 403 for pointing related information is the address or the like of the data region in which data of information related to the object having the foregoing ID number. When the related information pointer 403 for pointing related information is used, retrieval and display of information related to the object can easily be performed. The related information pointer 403 for pointing related information may be pointer for pointing data of description of a program or the operation of a computer. In the

foregoing case, when the object has been specified by a user, the computer performs a predetermined operation.

[0072]

The operation for describing the related information pointer 403 for pointing related information in the object region data will now be described. As an alternative to using the pointer 403, related information itself may be described in object region data. The related information pointer 403 for pointing related information and related information may be described in object region data. In the foregoing case, a flag is required to indicate whether the related information pointer for pointing related information or related information has been described in object region data.

[0073]

The approximate figure number 404 is the number of the figures approximating the object region. In the example shown in FIG. 2 in which the object region is approximated with one ellipse, the number of the figures is 1.

[0074]

Approximate figure data 405 is data (for example, the parameter of a spline function) of a trajectory of the representative point of the figure for expressing an approximate figure.

Note that approximate figure data 405 exists by the number corresponding to the approximate figure number 404 (a case where the approximate figure number 404 is two or

larger will be described later).

The number of the approximate figure number 404 for object region data may always be one (therefore, also approximate figure data 405 is always one) to omit the field for the approximate figure number 404.

[0075]

FIG. 6 shows the structure of approximate figure data 405.

[0076]

A figure type ID 1300 is identification data for indicating the type of a figure serving as the approximate figure, the figure type ID 1300 being arranged to identify a circle, an ellipse, a rectangle and a polygon.

[0077]

A representative point number 1301 indicates the number of representative points of the figure specified by the figure type ID 1300.

[0078]

A pair of representative point trajectory data items 1302 and 1303 are data regions relating to the spline function for expressing the trajectory of the representative points of the figure. The representative points of one figure require data of one pair of spline functions for the X and Y coordinates. Therefore, data of the trajectory of the representative points for specifying the spline function exists by representative point number (M) × 2.

[0079]

Note that the type of the employed approximate figure may previously be limited to one type, for example, an ellipse. In the foregoing case, the field for the figure type ID 1300 shown in FIG. 6 may be omitted.

[0080]

When the representative point number is defined according to the figure type ID, the representative point number may be omitted.

[0081]

FIG. 7 shows an example of the structure of representative point trajectory data 1302 and 1303.

[0082]

A knot frame number 1400 indicates the knots of the spline function. Thus, a fact that polynomial data 1403 is effective to the knots is indicated. The number of coefficient data 1402 of the polynomial varies according to the highest order of the spline function (assuming that the highest order is K, the number of coefficient data is K + 1). Therefore, reference to a polynomial order 1401 is made. Subsequent to the polynomial order 1401, polynomial coefficients 1402 by the number corresponding to the polynomial order (K) + 1 follows.

[0083]

Since the spline function is expressed in an individual polynomial ~~among the knots~~, the polynomials are required by the number corresponding to the number of knots. Therefore,

data 1403 including the knot frame number and the coefficient of the polynomial is described repeatedly. When the knot frame number is the same as the trailing end frame, it means the trailing end polynomial coefficient data. Therefore, termination of representative point trajectory data can be understood.

[0084]

A case will now be described in which a figure except for the ellipse is employed as the approximate figure.

[0085]

FIG. 8 is diagram showing the representative points in a case where a parallelogram is employed as the approximate figure. Points, A, B, C and D are vertices of the parallelogram. Since three points of the four vertices are determined, the residual one is determined. Therefore, three vertices among the four vertices are required to serve as the representative points. In the foregoing example, three points, which are A, B and C, are employed as the representative points.

[0086]

FIG. 9 is a diagram showing representative points in a case where a polygon is employed to serve as the approximate figure. In the case of the polygon, the order of the vertices is made to be the order along the outer surface. Since the example shown in FIG. 9 has 10 vertices, all of the vertices N_1 to N_{10} are employed as the representative points. In the foregoing case, the number of

the vertices may be reduced by employing only vertices each having an internal angle smaller than 180° as the representative points.

[0087]

As described above, the foregoing process may be performed by software which is operated on a computer. FIG. 10 is a flowchart showing the process which is performed by the video processing apparatus according to this embodiment. When the video processing apparatus according to this embodiment is realized by software, a program according to the flowchart shown in FIG. 10 is produced.

[0088]

In step S11, video data for one frame is extracted from the video data storage portion 100.

[0089]

In step S12, the region of a predetermined object in the video is extracted. Extraction may be performed by a method similar to that employed by the region extracting portion 101.

[0090]

In step S13, an approximate figure is approximated to region data which is a result of the process performed in step S12. The approximation method may be similar to that employed by the region figure approximating portion 102.

[0091]

In step S14, the representative points of the figure

approximated in step S13 is extracted.

[0092]

In step S15, approximation of the position of a representative point train of the approximate figure in the successive frame with a curve is performed.

[0093]

In step S16, a branching process is performed. Thus, determination is made whether or not the processed image is in the final frame or whether or not the object in the processed frequency which is to be extracted has disappeared from the image (or considered that the object has disappeared). In an affirmative case, the process is branched to step S17. In a negative case (both of the cases are negated), the process is branched to step S11.

[0094]

In step S17, the approximate curve calculated in step S15 is recorded in a recording medium as object region data in accordance with a predetermined format.

[0095]

The example has been described with which one figure is assigned to one object to roughly express the object region. The accuracy of approximation may be improved by making approximation to the region of one object with a plurality of figures. FIG. 11 shows an example in which a plurality of figures are approximated to one object. In the foregoing case, a region of a person in the image is expressed with 6 ellipses 600 to 605.

[0096]

When one object is expressed with the plural figures as shown in FIG. 11, a process for dividing the object into a plurality of regions must be performed. The process may be performed by an arbitrary method. For example, a method with which the object is directly divided with manpower may be employed. In the foregoing case, a pointing device, such as a mouse, is used to, on the image, enclose the region with a rectangle or an ellipse. Alternatively, the region is specified with a trajectory of the pointing device. When an automatic method is employed as a substitute for the manpower, a method may be employed with which clustering of movement of the object is performed to realize the division. The foregoing method is a method with which the movement of each region in the object among the successive frames is determined by a correlation method (refer to, for example, Image Analysis Handbook Chapter-3, Section II, Publish Conference of Tokyo University, 1991) or a method with gradient constraints (refer to, for example, Determining optical flow, B. K. P. Horn and B. G. Schunck, Artificial Intelligence, Vol. 17, pp. 185-203, 1981) to collect similar movements to form a region.

[0097]

Each of the divided regions is subjected to the process which is performed by the example of the structure shown in FIG. 1 or the procedure shown in FIG. 10 so that data of the approximate figure is produced. In the foregoing case, the

spline function, which must be described in object region data of one object increases as the number of the approximate figures increases. Therefore, the structure of data is formed which includes approximate figure data 405 by the number (L in the foregoing case) corresponding to the approximate figure number 404, as shown in FIG. 12.

[0098]

As described above, the field for the approximate figure number 404 may be omitted by making the approximate figure number to always be one (therefore, data of the approximate figure is made to always be one) to the object region data. In the foregoing case, one object can be expressed with a plurality of figures when object region data is produced for each figure approximating one object (the same ID number is given).

[0099]

When one object is expressed with a plurality of figures in this embodiment, the same figure is employed. A mixture of a plurality types of figures may be employed.

[0100]

Variation of a method of use of region data produced and recorded in this embodiment will now be described. Although a person, an animal, a building or a plant is considered as the object in a video, the process according to this embodiment may be applied to any object in the video. For example, a telop may be handled as an object in a video. Therefore, a process in which a telop is employed as the

variations of the object will now be described.

[0101]

The telop is character information added to the image. In U.S. character information called a "closed caption" must be added. In broadcasts in Japan frequencies of use of telops have been increased. The telop which must be displayed includes a moving telop, such as a still telop, a telop which is scrolled upwards in the screen and a telop which is scrolled from right to the left of the screen. When the region in which the telop is being displayed is approximated with a figure to store the telop character train as related information, the contents of the image can easily be recognized or a predetermined image can easily be retrieved.

[0102]

The region extracting portion 101 performs a process by employing a method with which a telop region is manually specified. Another method may be employed which has been disclosed in "Method of Extracting Character Portion from Video to Recognize Telop" (Hori, 99-CVIM-114, pp. 129-136, 1999, "Information Processing Society of Japan Technical Report") and with which the brightness and edge information of characters are employed to perform character train extracting method. Another method has been disclosed in "Improvement in Accuracy of Newspaper Story Based on Telop Character Recognition of News Video" (Katayama et al. Vol. 1, pp. 105-110, proceedings of Meeting on Image (Recognition

and Understanding (MIRU '98)) to separate background and the telop from each other by examining the intensity of edges. Thus, the telop region is extracted. Each character and each character train may be cut from the obtained telop region. Edge information in the telop region in successive frames is compared with each other to detect a frame in which the telop has appeared and a frame in which the same has disappeared.

[0103]

The region figure approximating portion 102 performs a process to approximate the telop region extracted by the region extracting portion 101 with a rectangle. The number of the frequency in which the telop has appeared is stored in the leading frame number of object region data (401 shown in FIG. 4 or FIG. 12). On the other hand, the frame in which the telop has disappeared is stored in the trailing frame number 402. A pointer for pointing the character train information of the telop is stored in the related information pointer 403 for pointing related information. As approximate figure data 405, rectangular region data encircling the telop is stored. When each row of a telop composed of a plurality of rows is made to be an individual region or when each character is made to be an individual region, the number of rows or characters is stored in the approximate figure number 404. Rectangular region data encircling each row or character, that is, approximate figure data 405, is stored by the corresponding

number.

[0104]

The figure-representative-point extracting portion 103 and the representative point trajectory curve approximating portion 104 perform processes as described above because any specialized portion for the telop is included in the processes.

[0105]

The character train information of the telop which has appeared is stored in the related information storage portion 105. Moreover, the pointer for pointing information above is stored in telop region data (object region data).

[0106]

When a keyword has been input and a character train corresponding or relating to the keyword is included in the character train information of the telop, the frame and time at which the character train appears can easily be detected. If the image is a news program, retrieval of interesting articles is permitted to look only the articles.

[0107]

In the foregoing case, addition of a pointer for pointing object region data corresponding to the frame or time to the character train information of the telop facilitates the retrieval.

[0108]

Thus, the telop is processed as described above. Variations of the object may be applied to the method of

using this embodiment.

[0109]

A method of providing video data and object region data will now be described.

[0110]

When object region data produced owing to the process according to this embodiment is provided for a user, a creator must provide object region data for the user by a method of some kind. The object region data may be provided by any one of the following methods.

(1) A method with which video data, its object region data and its related information are recorded in one (or a plurality of) recording medium so as to simultaneously be provided.

(2) A method with which video data and object region data are recorded in one (or a plurality of) recording medium so as to simultaneously be provided. However, related information is individually provided or provision of the same is not performed (the latter case is a case in which related information can individually be acquired through a network or the like if provision is not performed).

(3) A method with which video data is solely provided. Moreover, object region data and related information are recorded in one (or a plurality of) recording medium so as to simultaneously be provided.

(4) A method with which video data, object region data and related information are individually provided.

The recording medium is mainly used to perform provision in the foregoing case. Another method may be employed with which a portion or the overall portion of data is provided from a communication medium.

[0111]

(Second Embodiment)

The first embodiment has the structure that the representative points of a figure approximating the object region in a video is extracted so as to be converted into object region data. On the other hand, a second embodiment has a structure that characteristic points in the object region in the video are extracted so as to be converted into object region data.

[0112]

Description will be made about the different structures from those according to the first embodiment.

[0113]

FIG. 13 shows an example of the structure of an object-region-data converting apparatus according to this embodiment. As shown in FIG. 13, the object-region-data generating apparatus according to this embodiment incorporates a video data storage portion 230, a characteristic-point extracting portion 233, a characteristic-point-curve approximating portion 234 for approximating the arrangement of characteristic points with a curve, a related information storage portion 235 and a region data storage portion 236.

[0114]

Referring to FIG. 13, a video data storage portion 230 has the same function as that of the video data storage portion 100 according to the first embodiment. The related information storage portion 235 has the same function as that of the related information storage portion 105 according to the first embodiment. The region data storage portion 236 has the same function as that of the region data storage portion 106 according to the first embodiment.

[0115]

The characteristic-point extracting portion 233 extracts at least one characteristic point from the object region in the video. The characteristic point may be any one a variety of points. For example, corners of an object (for example, a method disclosed in "Gray-level corner detection, L. Kitchen and A. Rosenfeld, Pattern Recognition Letters, No. 1, pp. 95-102, 1982) or the centroid of the object may be employed. When the centroid of the object is employed as the characteristic point, it is preferable that the portion around the point assumed as the centroid is specified and then automatic extraction is performed.

[0116]

The characteristic-point-curve approximating portion 234 has a basic function similar to that of the representative point trajectory curve approximating portion 104 according to the first embodiment. That is, the characteristic-point-curve approximating portion 234

time-sequentially approximates, to a curve, the positions of the characteristic points extracted by the characteristic-point extracting portion 233. The approximate curve is, for each of the X and Y coordinates, expressed as the function of the frame number f or the time stamp t given to the video so as to be approximated with a curve by linear approximation or approximation using a spline curve. Data after the approximation has been performed is recorded by a method similar to that according to the first embodiment.

[0117]

Note that object region data according to this embodiment is basically similar to object region data according to the first embodiment (see FIG. 5). The field for the approximate figure number is not required. Note that "data of the approximate figure" is "data of characteristic points".

[0118]

Also data of the characteristic point in object region data is basically similar to data of the approximate figure according to the first embodiment (see FIG. 6). Note that the "number of representative points" is the "number of characteristic points". The "data of the trajectory of representative points" is the "data of the trajectory of characteristic points". Note that figure type ID is not required.

[0119]

Data of the trajectory of the characteristic points included in the data of the characteristic points is similar to data of the trajectory of the representative points according to the first embodiment (see FIG. 7).

[0120]

FIG. 14 is a flowchart showing an example of a flow of the process of the object-region-data converting apparatus according to this embodiment. The overall flow is similar to that according to the first embodiment. Steps S12 to S14 shown in FIG. 10 are made to be step for extracting the characteristic points of the object of interest. The representative point in step S15 shown in FIG. 10 is made to be the characteristic point.

[0121]

As a matter of course, the process according to this embodiment can be realized by software.

[0122]

As described above, the structure according to this embodiment is able to describe the object region in a video as a parameter of a curve approximating the time-sequential trajectory (the trajectory of the coordinates of the characteristic points having the frame numbers or time stamps as the variables) of the characteristic points of the region.

[0123]

Since this embodiment enables the object region in

a video to be expressed with only the parameters of the function, object region data, the quantity of which can be reduced and which can easily be handled, can be generated. Moreover, expression of the characteristic points and generation of the parameters of the approximate curve can easily be performed.

[0124]

According to this embodiment, whether or not arbitrary coordinates specified by a user indicate the object region can considerably easily be determined. Moreover, it leads to a fact that specification of a moving object in a video can furthermore easily be performed.

[0125]

Note that object region data based on the representative points of the approximate figure of the object region according to the first embodiment and object region data based on the characteristic points of the object region according to the second embodiment may be mixed with each other.

In the foregoing case, the format of object region data according to the first embodiment is provided with a flag for identifying a fact that object region data is based on the representative points of the approximate figure of the object region or the characteristic points of the object region. As an alternative to providing the flag for the format of object region data according to the first embodiment, when the figure type ID has a specific value,

a fact that object region data is based on the characteristic points of the object region is indicated. In the other cases, a fact is indicated that object region data is based on the representative points of the approximate figure of the object region.

[0126]

The structure of object region data and a creating side have been described. The portion for using the above-mentioned object region data will now be described.

[0127]

(Third Embodiment)

In the third embodiment, when object region data including related information has been given to the object in the video, a user specifies an object (mainly on a GUI screen) to display related information (display of characters, a still image or a moving image, or output of sound) or causes a related program to be executed.

[0128]

FIG. 15 shows an example of the structure of a data processing apparatus according to this embodiment. As shown in FIG. 15, the data processing apparatus according to this embodiment incorporates a video data display portion 301, a control unit 302, a related information display portion 303 and an instruction input portion 304.

[0129]

The video data display portion 301 displays video data input from a recording medium or the like (not shown)

on a liquid crystal display unit or a CRT.

[0130]

The instruction input portion 304 permits a user to use a pointing device, such as a mouse, or a keyboard to perform an operation, for example, specification of an object in the video displayed on the liquid crystal unit or the CRT. Moreover, the instruction input portion 304 receives input from the user.

[0131]

The control unit 302, to be described later, determines whether or not the user has specified the object in the video in accordance with, for example, the coordinates specified by the user on the screen and object region data input from a recording medium (not shown). Moreover, the control unit 302 makes a reference to the pointer for pointing related information of object region data when a determination has been made that the user has specified a certain object in the video. Thus, the control unit 302 acquires related information of the object to display the related information.

[0132]

The related information display portion 303 responds to the instruction issued from the control unit 302 to acquire and display related information (from a recording medium or a server or the like through a network).

[0133]

When the pointer for pointing related information is

a pointer for pointing data in which program or the operation of the computer is described, the computer performs a predetermined operation.

[0134]

As a matter of course, also this embodiment may be realized by software.

[0135]

A process which is performed when the object region is expressed as an approximate figure similarly to the first embodiment will now be described.

[0136]

FIG. 16 shows an example of the process according to this example. The flowchart shown in FIG. 16 includes only a process which is performed when a certain region in a video which is being displayed during reproduction of the video is specified by using a pointing device, such as a mouse cursor (basically corresponding to the process which is performed by the control unit 302).

[0137]

In step S31, the coordinates on the screen specified by using the pointing device or the like are calculated. Moreover, the frame number of the video which is being reproduced at the moment of the instruction is acquired. Note that a time stamp may be employed as a substitute for the frame number (hereinafter the frame number is employed).

[0138]

In step S32, the object existing in the video having

the frame number in which the object has been specified is selected from object region data of the object added to the video. The foregoing selection can easily be performed by making a reference to the leading frame number and the trailing frame number of object region data.

[0139]

In step S33, data of a spline function (see FIGS. 6 and 7) extracted from object region data of the region selected in step S32 is used to calculate the coordinates of the representative points of the approximate figure in the video display frame number when the object has been specified. Thus, two focal points F and G and point H on the ellipse are obtained in the example according to the first embodiment (see FIGS. 2 and 4).

[0140]

In step S34, it is determined whether or not the coordinates specified by using the pointing device or the like exist in the object (that is, the approximate figure) in accordance with the discrimination procedure which is decided according to the obtained representative points and the figure type ID of object region data.

[0141]

When the ellipse is represented by the two focal points and one point on the ellipse similarly to the first embodiment, the determination can easily be made.

[0142]

When, for example, the Euclidean distance between

points P and point Q is expressed by E (P, Q) similarly to the first embodiment, the following inequality is held in a case where the coordinate P specified by using the pointing device exists in the ellipse:

$$E(F, P) + E(G, P) \leqq E(F, H) + E(G, H)$$

[0143]

In a case where the coordinate P exists on the outside of the ellipse, the following inequality is held:

$$E(F, P) + E(G, P) > E(F, H) + E(G, H)$$

The foregoing inequalities are used to determine whether or not the specified point exists in the object. Then, it is determined whether step S35 is performed or omitted (skipped) in accordance with a result of the determination.

[0144]

When a parallelogram is employed as the approximate figure of the object region in the video, four inequalities are used as a substitution for one inequality in the case of the ellipse to determine whether or not the arbitrary coordinates exist in the object.

[0145]

When, for example, points A, B and C shown in FIG. 8 are representative points, point D is obtained as follows:

$$D = C + A - B$$

Then, an assumption is made that a point on a straight line passing through the points A and B is Q and the straight line is expressed by the following equation:

$f_{A,B}(Q) = 0$

When the point P exists in the figure, the following four inequalities are held:

$f_{A,B}(P) \leqq 0$

$f_{C,D}(P) \geqq 0$

$f_{B,C}(P) \leqq 0$

$f_{D,A}(P) \geqq 0$

where the constant term of the equation $f_{A,B}(P)=0$ is larger than the constant term of the equation $f_{C,D}(P)=0$, and the constant term of the equation $f_{B,C}(P)=0$ is lager than the constant term of the equation $f_{D,A}(P)=0$.

When the coordinate of point P is (x,y), $f_{A,B}(P)$ is obtained by following equation.

$$y - y_A - (y_A - y_B)/(x_A - x_B) \cdot (x - x_A) = 0$$

[0146]

When approximation to one object with a plurality of approximate figures is made (refer to the approximate figure number shown in FIGS. 5 and 12), the foregoing process is performed for each approximate figure.

[0147]

In step S35, a process which is performed only when the specified point exists in the object region. In the foregoing case, a reference to "the related information pointer" contained in object region data is made. In accordance with information about the pointer, related information is acquired so as to be, for example, displayed (in the example of the structure shown in FIG. 15, the

foregoing process is performed by the related information display portion 303). When a program has been specified as related information, an specified program is executed or another specified operation is performed. When related information has been described in object region data, related information is required to be displayed.

[0148]

FIG. 17 shows an example of a case where description (a text) of an object in a video has been given as the related information. When the coordinates specified by using the pointing device 802 during reproduction of a video 800 exist in the object region 801 (a figure approximating the object 801), related information 803 is displayed.

[0149]

In step S36, a branching process is performed so that it is determined whether or not an object having object region data furthermore exists in the frame in which the object has been specified. If the object exists, the process proceeds to step S32. If the object does not exist, the operation is completed.

[0150]

A process which is performed when the object region is expressed as characteristic points of the object similarly to the second embodiment will now be described.

[0151]

The portions different from those according to the first embodiment will mainly be described.

[0152]

FIG. 18 shows an example of the procedure according to this example. Note that the flowchart shown in FIG. 18 includes only a process (basically, corresponding to the process which is performed by the control unit 302) which is performed when a certain region in a video which is being displayed during reproduction of the video has been specified by using a pointing device, such as a mouse cursor. Since the overall flow is similar to that of the flowchart shown in FIG. 16, different portions will mainly be described (steps S41, S42, S45 and S46 are similar to steps S31, S32, S35 and S36).

[0153]

In step S43, the coordinates of the position of the characteristic point of an object in a displayed frame number are calculated from object region data. When a plurality of characteristic points exist, the coordinates of all of the characteristic points are calculated.

[0154]

In step S44, the distance between the position of the characteristic point calculated in step S43 and the coordinates specified by clicking is calculated for all of the characteristic points. Then, it is determined whether or not one or more characteristic point positioned distant for a distance shorter than a predetermined threshold value. Alternatively, a process for calculating the distance for a certain characteristic point and comparing the distance

with a predetermined threshold value is repeated. When one characteristic point positioned distant for a distance shorter than the threshold value is detected, the process is interrupted. If one or more characteristic points distant for a distance shorter than the threshold value exits, the process proceeds to step S45. If no characteristic point of the foregoing type does not exist, the process proceeds to step S46.

[0155]

As a result of the foregoing process, display of related information can be performed in accordance with the coordinates of the characteristic point of the object when a portion adjacent to the region of the interest has been specified by an operation using a pointing device or the like.

[0156]

(Fourth Embodiment)

A fourth embodiment will now be described with which an object region having related information which can be displayed is clearly displayed (communicated to a user) by using object region data. In the foregoing case, the object having related information which can be displayed must previously be supplied with object region data including a pointer for pointing the related information.

[0157]

The block structure of this embodiment is similar to that according to, for example, the third embodiment (see

FIG. 15).

[0158]

As a matter of course, also this embodiment can be realized by software.

[0159]

A case in which the object region has been expressed as an approximate figure similar to the first embodiment will now be described.

[0160]

FIG. 19 shows an example of a process according to this embodiment.

[0161]

An example case in which the approximate figure is an ellipse will now be described. As a matter of course, a similar process is performed in a case of another approximate figure.

[0162]

In step S51, the frame number of a video which is being displayed is acquired. Note that a time stamp may be employed as a substitute for the frame number (hereinafter the frame number is employed).

[0163]

In step S52, an object having the frame number acquired in step S51 and existing in the video is selected. The selection is performed by detecting data having a displayed frame number between the leading frame number of object region data given to the video and the trailing frame number.

[0164]

In step S53, data of a spline function (see FIGS. 6 and 7) is extracted from object region data of the object selected in step S52. Then, the coordinates of representative points of an approximate figure (or a region having related information) in the displayed frame are calculated.

[0165]

In step S54, a reference to the figure type ID of object region data is made to obtain an approximate figure expressed by the representative points calculated in step S53. Then, display of the image in each approximate figure (for example, an ellipse region) is changed.

[0166]

The change may be performed by a variety of methods. When the approximate figure is, for example, an ellipse, the brightness of the image in the ellipse region is intensified by a predetermined value. Assuming that the degree of intensification is ΔY, the brightness before the change of the display is Y and an upper limit of the brightness which can be displayed is Ymax, each pixel in the ellipse is displayed with brightness of $MIN(Y + \Delta Y, Ymax)$. Pixels on the outside of the ellipse are displayed with brightness of Y. Note that MIN(a, b) is a function taking a smaller value of a and b.

[0167]

FIG. 20 shows an example with which the object region

is displayed by the method with which the brightness is intensified (in FIG. 20, hatching indicates no change in the brightness and no hatching indicates intensified brightness). FIG. 20(a) shows a screen 1000 which is in a state in which the display change process in step S54 has not been performed. Reference numeral 1001 represents an object having object region data in the video. A screen 1002 shown in FIG. 20(b) is displayed after the change in the display in step S54 has been performed. Reference numeral 1003 represents an ellipse region approximating the object region 1001. Display of only the inside portion of the ellipse region 1003 is brightened. Thus, a fact that the object is an object which permits display or the like of related information can be recognized.

[0168]

When one object is approximated with a plurality of approximate figures (refer to approximate figure number shown in FIGS. 5 and 12), the foregoing process is performed for each approximate figure.

[0169]

In step S55, it is determined whether or not another object, the display of which must be changed, exists. A determination is made whether or not a non-processed object having a display frame number which is between the leading frame number and the trailing frame number exists. If the non-processed object exists, the process from step S52 is repeated. If no object of the foregoing type exists,

the process is completed.

[0170]

As described above, display of an object region having the related information among the regions of the object in the video which is specified by using object region data is changed. Thus, whether or not the related information exists can quickly be detected.

[0171]

A method of indicating the object region which permits display or the like of related information may be the above-mentioned method with which the brightness in the object region is changed. Any one of a variety of methods may be employed. A variety of the methods will now be described. The procedure of each process using object region data is basically similar to the flowchart shown in FIG. 19. Therefore, step S54 is changed to a corresponding process.

[0172]

A display method shown in FIG. 21 is a method of displaying the position of an object having related information on the outside of an image 1600. Reference numerals 1601 and 1602 represent objects having related information. Reference numerals 1603 and 1604 represent bars for displaying the position of the object in the direction of the axis of ordinate and in the direction of the axis of abscissa. Display 1605 and display 1606 correspond to the object 1601 having related information. FIG. 21 shows a structure that bars serving as marks are

displayed in the regions in which the region 1601 are projected in the direction of the axis of ordinate and in the direction of the axis of abscissa. Similarly, reference numerals 1607 and 1608 represent bars for displaying the object region 1602.

[0173]

A state of projection of the object region in the foregoing directions can easily be obtained by using the coordinates of the representative points of the approximate figure in the frame obtained from data of the approximate figure of object region data and the figure type ID as described in the embodiments.

[0174]

It is preferable that the region of a different object is indicated with a bar displayed in a different manner (for example, a different color).

[0175]

The method according to this embodiment causes a user to specify the inside portion of the image in accordance with the bars 1603 and 1604 displayed in the vertical and horizontal directions on the outside of the image 1600 by using a pointing device. Thus, related information can be displayed.

[0176]

FIG. 22 shows another display method with which the position of an object having related information is displayed on the outside of an image 1700. Objects 1701 and

1702 each having related information exist in the image 1700. The position of the object having related information is indicated by an object-position indicating bars 1703 and 1704. As distinct from the example shown in FIG. 21, each display bar indicates only the position of the centroid the object as a substitute for the object region. Circles 1705 and 1706 indicate the centroid of the object 1701. Circles 1707 and 1708 indicate the centroid of the object 1702.

[0177]

Also the centroid of the object region in the foregoing directions can easily be obtained in accordance with the coordinates of the representative point of the approximate figure in the frame obtained from data of the approximate figure of object region data and the figure type ID.

[0178]

The foregoing method enables display which can easily be recognized because the size of display on the object position indicating bar can be reduced if the object has a large size or many objects exit.

[0179]

FIG. 23 shows an example of a display method with which a related information list is displayed on the outside of an image 1800. The image 1800 contains objects 1801 and 1802 each having related information. Reference numeral 1803 represents a list of objects each having related information. The list 1803 shows information of objects each having related information in the image frame which is

being displayed. In the example shown in FIG. 23, names of objects are displayed which are obtained as a result of retrieving related information from object region data of the objects existing in the frame.

[0180]

The foregoing method permits a user to cause related information to be displayed by specifying the name shown in the related information list 1803 as well as the specifying the region 1801 or 1802 with the pointing device. Since also instruction of the number shown in the list 1803 enables related information to be displayed, the foregoing structure can be employed in a case of a remote control having no pointing device.

[0181]

FIG. 24 shows a display method with which objects 1901 and 1902 existing in an image 1900 and each having related information are indicated with icons 1903 and 1904 to indicate existence of related information. The icon 1903 corresponds to the object 1901, while the icon 1904 corresponds to the object 1902.

[0182]

Each icon can be displayed by obtaining an approximate figure as described above, by cutting a rectangle region having a predetermined size including the obtained approximate figure from video data in the frame and by, for example, arbitrarily contracting the cut rectangle region.

[0183]

The foregoing method enables related information to be displayed by directly specifying the icon as well as specifying the object region in the video.

[0184]

FIG. 25 shows an example of a display method configured to display a map indicating the object region having related information so as to indicate existence of related information. An image 2000 includes objects 2001 and 2002 each having related information. Reference numeral 2003 represents a map of the regions of the objects each having related information. The map 2003 indicates the positions of the regions of the objects each having related information in the image 2000. Reference numeral 2004 represents the object 2001, while reference numeral 2005 represents the object 2002.

[0185]

The map 2003 has a form obtained by reducing the image 2000 and arranged to display only the images of the object regions (only the approximate figures obtained as described above are displayed at the corresponding positions in the contracted image).

[0186]

It is preferred that a region indicating bar has different display forms with respect to the different objects.

[0187]

The foregoing method enables related information to be displayed by specifying the object region displayed on the map 2003 as well as direct specification of an object in the image 2000.

[0188]

FIG. 26 shows an example of the display method with which specification of an object existing in the image and having related information is facilitated by using a pointing device by controlling reproduction rate of the image at the position of the mouse cursor. Reference numerals 2100 and 2102 represent the overall bodies of the display screens and reference numerals 2101 and 2103 represent regions on the display screens on which images are being displayed. In the display screen 2100 shown in FIG. 26(a), a mouse cursor 2104 is positioned on the outside of the image 2101 so that the image is reproduced at a normal display rate. In the display screen 2102 shown in FIG. 26(b), the mouse cursor 2105 exists in the image region 2103. Therefore, display rate of the image is lowered or displayed image is frozen.

[0189]

Another structure may be employed as a substitute for the above-mentioned structure in which image display rate is always lowered or the displayed image is frozen when the mouse cursor has entered the image region. That is, whether or not an object having related information exists in the

frame is determined (determination is made by comparing the frame number and the leading frame number/trailing frame number with each other). If the object having related information exists in the frame, the image display rate is lowered or the displayed image is frozen.

[0190]

For example, an object which is moving at high speed in the video cannot sometimes easily be specified by using the mouse cursor. The foregoing method is arranged to change the reproducing speed according to the position of the mouse cursor. Thus, movement of the object can be slowed when the object is specified or the displayed image can be frozen. Hence it follows that instruction can easily be performed.

[0191]

FIG. 27 shows an example of the display method with which an object existing in the image and having related information can easily be specified by using the pointing device. Reference numeral 2500 represents an image which is being reproduced. Reference numeral 2501 represents a button for acquiring an image. When the button 2501 is depressed with a mouse pointer 2502, an image which has been displayed at the specified time can be acquired so as to be displayed on an acquired-image display portion 2503. The image 2500 is continuously reproduced even after the foregoing instruction has been performed with the button 2501. Since the acquired image is displayed on the acquired-image display portion 2503 for a while, instruction

of an object which is being displayed in the acquired-image display portion 2503 enables related information of the specified object to be displayed.

[0192]

The button 2501 for acquiring an image may be omitted. A structure may be employed from which the button 2501 is omitted and with which an image can automatically be acquired when the mouse cursor 2502 enters the video display portion 2500.

[0193]

A structure may be employed with which whether or not an object having related information exists in the frame is determined when the button 2501 has been depressed or the mouse cursor has entered the image region (for example, a determination is made by comparing the frame number and the leading frame number/trailing frame number with each other). Only when the object having related information exists in the frame, the image is acquired so as to be displayed.

[0194]

The foregoing method enables related information to easily be specified from a still image.

[0195]

The foregoing variations may be employed. Another method may be employed with which the region of an image which permits display or the like of related information is clearly displayed. Also a method may be employed with which

instruction is facilitated. Thus, a variety of methods for aiding the operation of the user may be employed.

[0196]

A case in which the object region is expressed as characteristic points of the object similarly to the second embodiment will now be described.

[0197]

Portions different from those according to the first embodiment will mainly be described.

[0198]

A flowchart is, in the foregoing case, a flowchart which is basically similar to that shown in FIG. 19 except for characteristic points being employed as a substitute for the representative points. Specifically, the coordinates of characteristic points of the approximate figure are calculated in step S53.

[0199]

FIG. 20 shows the structure that the brightness in the approximate figure 1003 corresponding to the object 1001 is intensified. If three or more characteristic points exist in the foregoing case, a polygon having the vertices which are the characteristic points may be formed. Moreover, the brightness of the inside portion of the polygon may be intensified. If two or more characteristic points exist, a figure of some kind may be formed which has the representative points which are the characteristic points. Moreover, the brightness in the figure may be intensified.

Alternatively, a figure, such as a circle, the center of which is each of the characteristic points and which has a somewhat large size is formed. Moreover, each of the formed figure, which must be displayed, is made conspicuous by means of brightness, color or blinking.

[0200]

The structure shown in FIG. 21 is arranged such that projection of the approximate figures corresponding to the objects 1601 and 1602 in the vertical and horizontal directions is displayed as the bar set 1605 and 1607 or the bar set 1606 and 1608. If three or more characteristic points exist in the foregoing case, a polygon having the vertices which are the characteristic points may be formed. Moreover, projection of the polygon in the directions of the two axes may be displayed as the bars. If two or more characteristic points exist, a rectangle having the vertices which are the characteristic points may be formed. Moreover, projection into the directions of the two axes may be displayed as the bars. If one characteristic point exists, the foregoing method shown in FIG. 22 may be employed with which the position of the centroid is displayed with circles in the bars.

[0201]

FIG. 24 shows the structure with which the image of an object is extracted by cutting in accordance with the approximate figure or the like so as to be displayed as an icon. Also in the foregoing case, the image of an object

can be extracted by cutting in accordance with the characteristic points so as to be displayed as an icon.

[0202]

FIG. 25 shows a structure that the approximate figures 1903 and 1904 are displayed in a map. Also in the foregoing case, a figure of some kind formed in accordance with characteristic points as described above may be displayed as a map.

[0203]

The methods shown in FIGS. 23, 26 and 27 may employed in the foregoing case.

[0204]

The foregoing variations may be employed. Another method may be employed with which the region of an image which permits display or the like of related information is clearly performed. Also a method may be employed with which instruction is facilitated. Thus, a variety of methods for aiding the operation of the user may be employed.

[0205]

Each of the foregoing structures may be realized by a recording medium storing a program for causing a computer to execute a predetermined means (or causing the computer to act as a predetermined means or causing the computer to realize a predetermined function).

[0206]

The present invention in its broader aspects is not limited to the embodiments described herein. Accordingly,

various modifications may be made without departing from the spirit or scope of the general inventive concept.

[0207]

[Advantages of the invention]

The present invention is configured such that the object region in a video is described as the parameter of a function approximating the trajectory obtained by arranging positional data of representative points of the approximate figure of the object region or the characteristic points of the object region in a direction in which frames proceed. Therefore, the region of a predetermined object can be described with a small quantity of data. Moreover, creation and handling of data can easily be performed.

[0208]

According to the present invention, a user is able to easily instruct an object in a video and determine the object.

[Brief Description of the drawings]

[FIG. 1]

FIG. 1 is a diagram showing an example of the structure of an object-region-data generating apparatus according to a first embodiment of the present invention.

[FIG. 2]

FIG. 2 is diagrams showing a procedure for describing an object region in a video with object region data.

[FIG. 3]

FIG. 3 is a diagram showing an example of a process for approximating an object region with an ellipse.

[FIG. 4]

FIG. 4 is a diagram showing an example of a process for detecting a representative point of an approximate ellipse of an object region.

[FIG. 5]

FIG. 5 is a diagram showing an example of the structure of object region data.

[FIG. 6]

FIG. 6 is a diagram showing an example of the structure of data of an approximate figure in object region data.

[FIG. 7]

FIG. 7 is a diagram showing an example of the structure of data of a trajectory of a representative point in data of an approximate figure.

[FIG. 8]

FIG. 8 is a diagram showing an example of representative points when the approximate figure is a parallelogram.

[FIG. 9]

FIG. 9 is a diagram showing an example of representative points when the approximate figure is a polygon.

[FIG. 10]

FIG. 10 is a flowchart showing an example of

a procedure according to the first embodiment of the present invention.

[FIG. 11]

FIG. 11 is a diagram showing an example in which the object region in a video is expressed with a plurality of ellipses.

[FIG. 12]

FIG. 12 is a diagram showing an example of the structure of object region data including data of a plurality of approximate figures.

[FIG. 13]

FIG. 13 is a diagram showing an example of an object-region-data generating apparatus according to a second embodiment of the present invention.

[FIG. 14]

FIG. 14 is a flowchart showing an example of a procedure according to the second embodiment.

[FIG. 15]

FIG. 15 is a diagram showing an example of the structure of a video processing apparatus according to a third embodiment of the present invention.

[FIG. 16]

FIG. 16 is a flowchart showing an example of a procedure according to the third embodiment.

[FIG. 17]

FIG. 17 is a diagram showing an example of display of contents hyper media which uses object region data.

[FIG. 18]

FIG. 18 is a flowchart showing another example of the procedure according to the third embodiment.

[FIG. 19]

FIG. 19 is a flowchart showing an example of a procedure according to a fourth embodiment of the present invention.

[FIG. 20]

FIG. 20 is diagrams showing an example of change in the display of an object region having related information.

[FIG. 21]

FIG. 21 is a diagram showing another example of the display of the position of an object region having related information.

[FIG. 22]

FIG. 22 is a diagram showing another example of the display of the position of an object region having related information.

[FIG. 23]

FIG. 23 is a diagram showing an example of display of a description list of an object region having related information.

[FIG. 24]

FIG. 24 is a diagram showing an example of display of an object region having related information with an icon.

[FIG. 25]

FIG. 25 is a diagram of an example of display of

an object region having related information with a map.

[FIG. 26]

FIG. 26 is diagrams showing an example of control of an image reproducing rate for facilitating instruction of an object region.

[FIG. 27]

FIG. 27 is a diagram showing an example which enables image capture for facilitating instruction of an object region.

[Explanation of Reference numerals]

100, 230 … Video data storage portion,

101 … Region extracting portion,

102 … Region figure approximating portion,

103 … Figure-representative-point extracting portion,

104 … Representative point trajectory curve approximating portion,

105, 235 … Related information storage portion,

106, 236 … Region data storage portion,

233 … Characteristic-point extracting portion,

234 … Characteristic-point-curve approximating portion,

301 … Video data display portion,

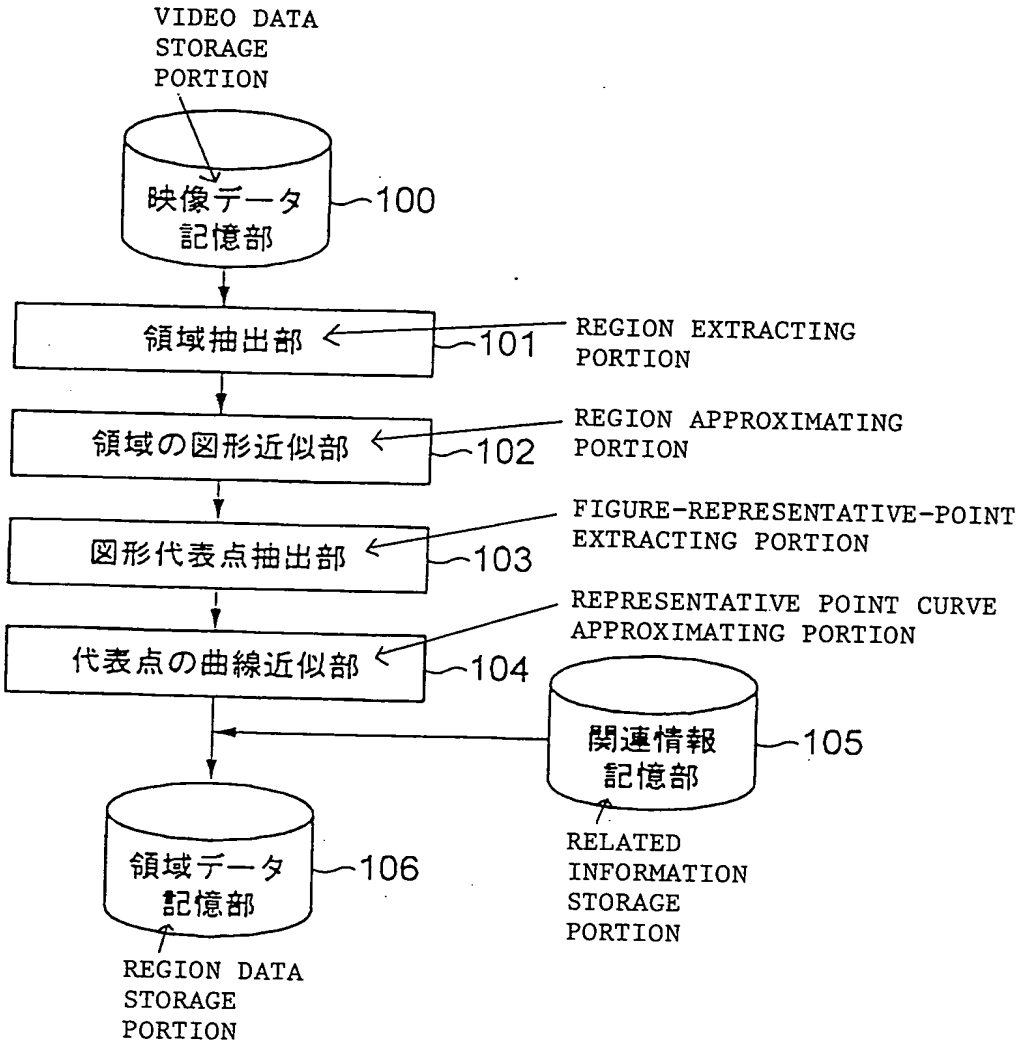
302 … Control unit,

303 … Related information display portion,

304 … Instruction input portion.

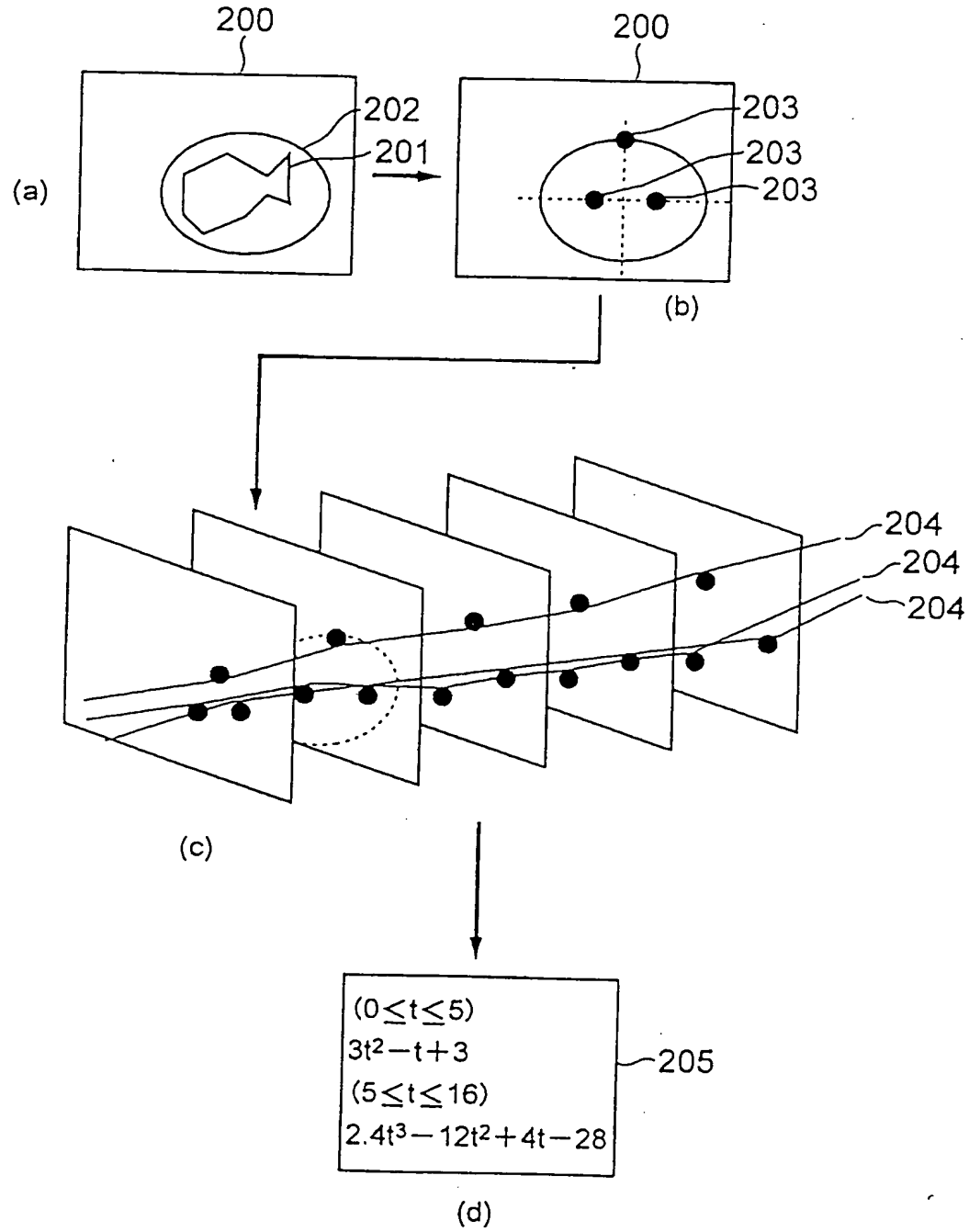
【書類名】 図面
NAME OF DOCUMENTS DRAWINGS
【図１】

[FIG. 1]



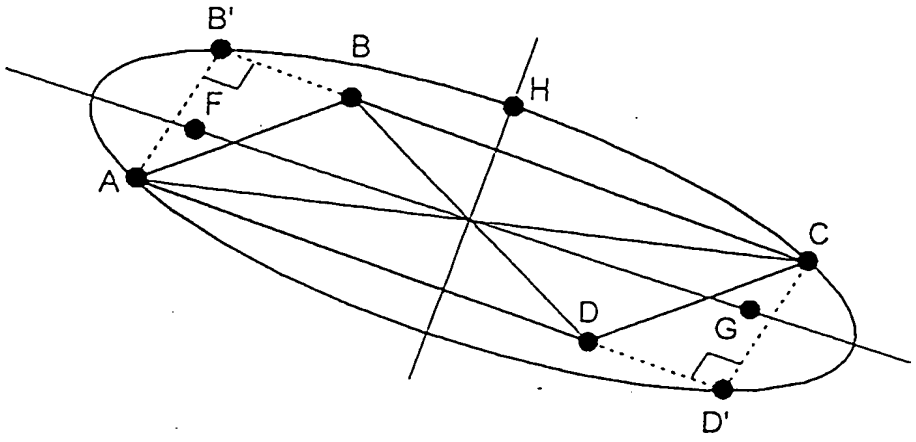
【図２】

[FIG. 2]


200
200
202
201
203
203
203
(a)
(b)
204
204
204
(c)
(0≤t≤5)
3t²−t+3
(5≤t≤16)
2.4t³−12t²+4t−28
205
(d)

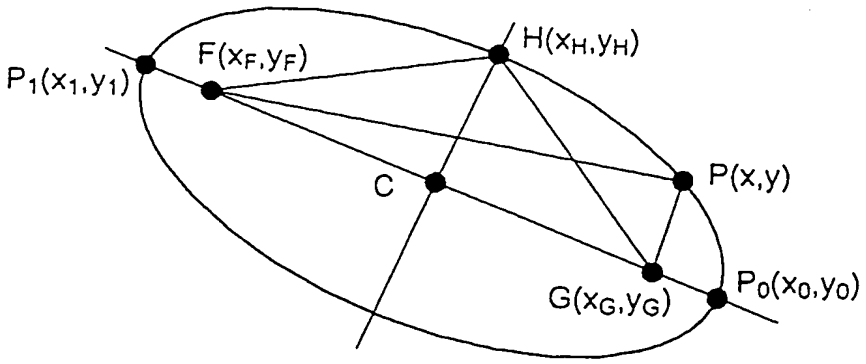
【図３】

[FIG. 3]



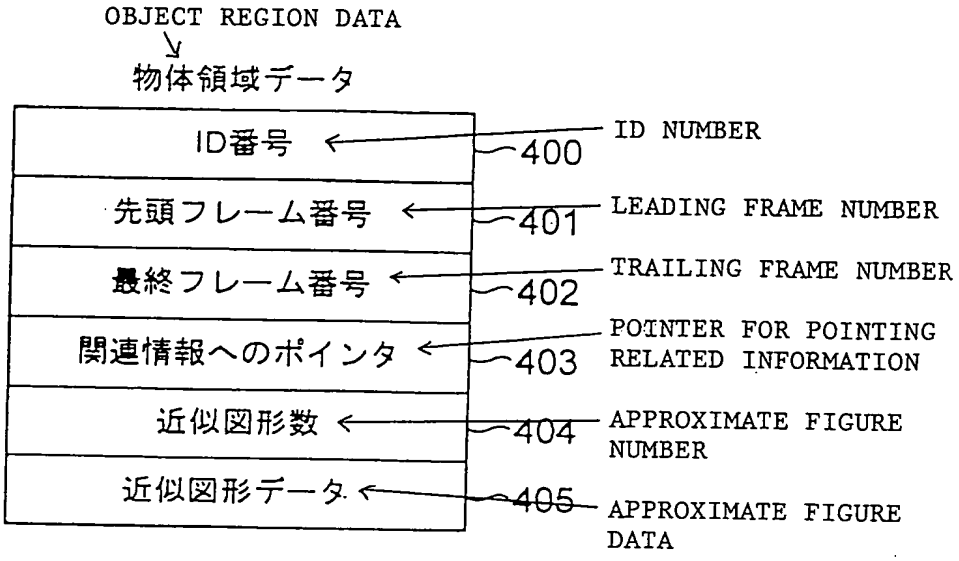
【図４】

[FIG. 4]



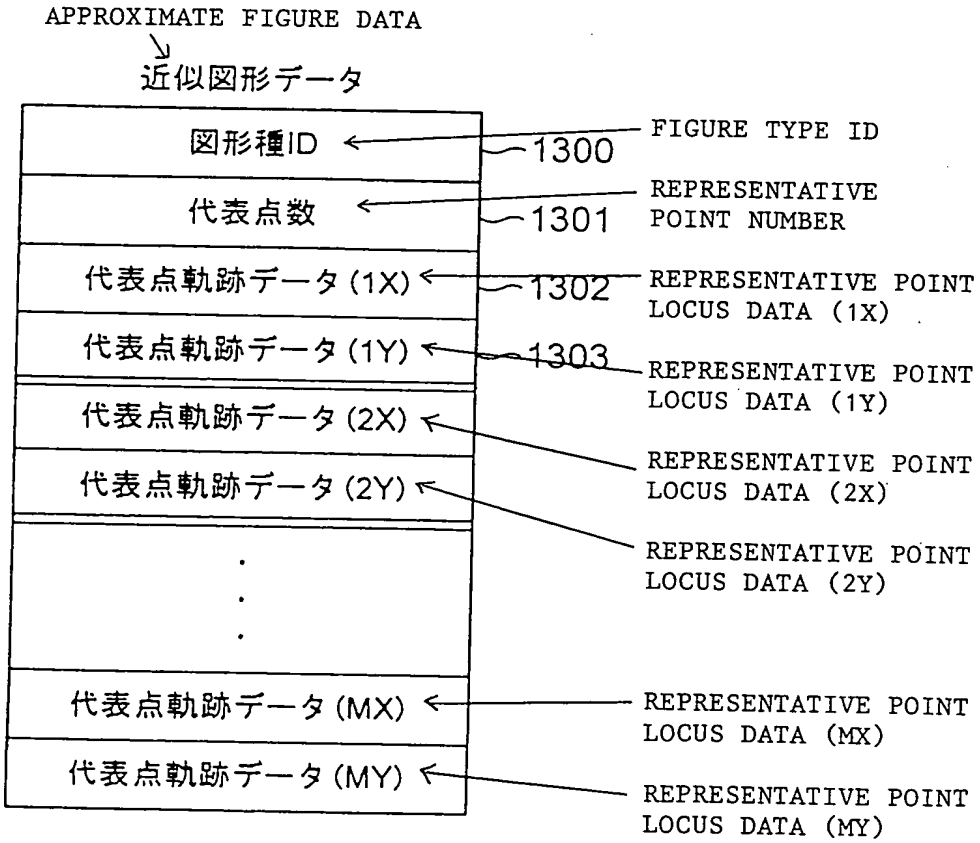
【図５】

[FIG. 5]



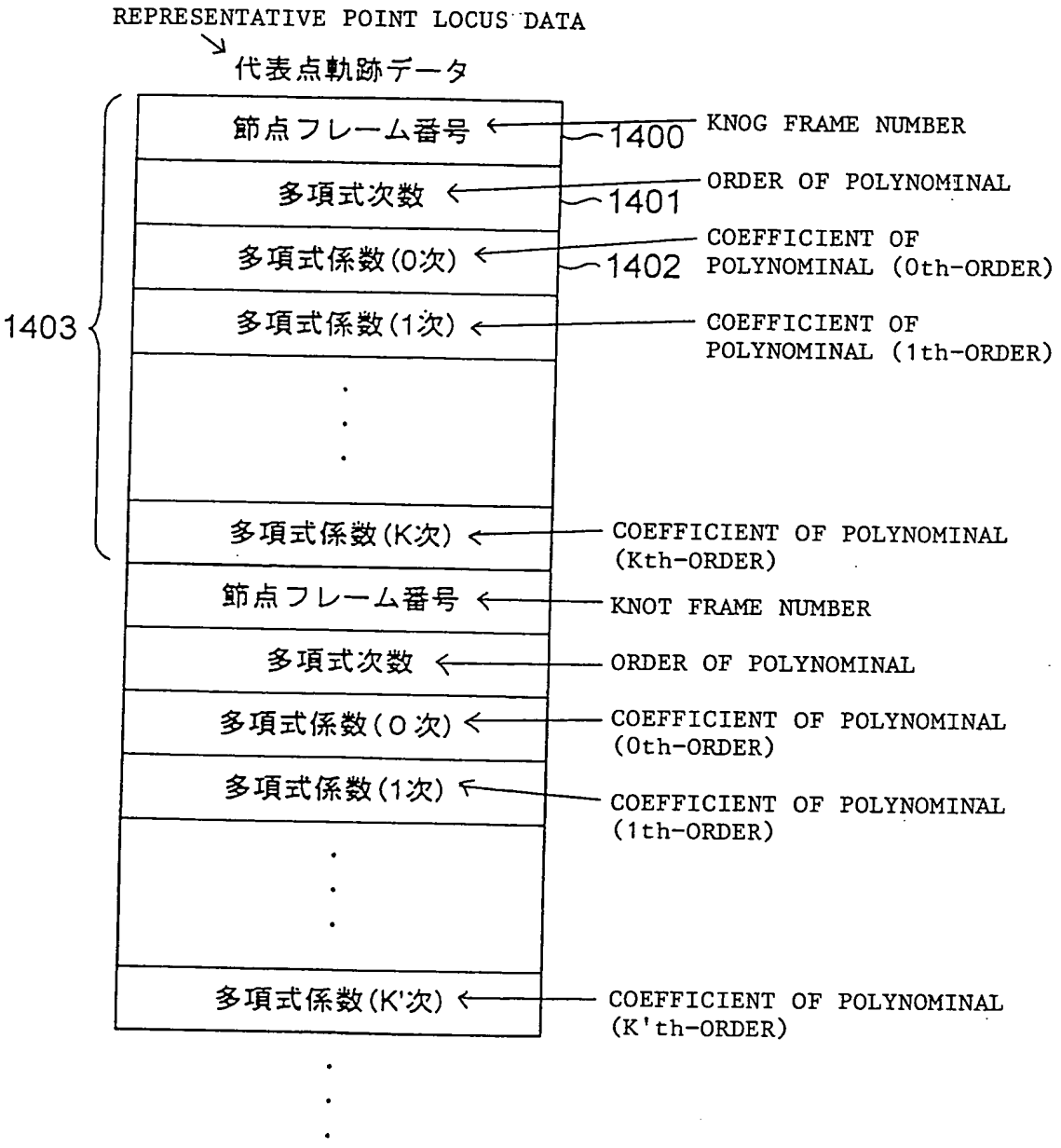
【図６】

[FIG. 6]



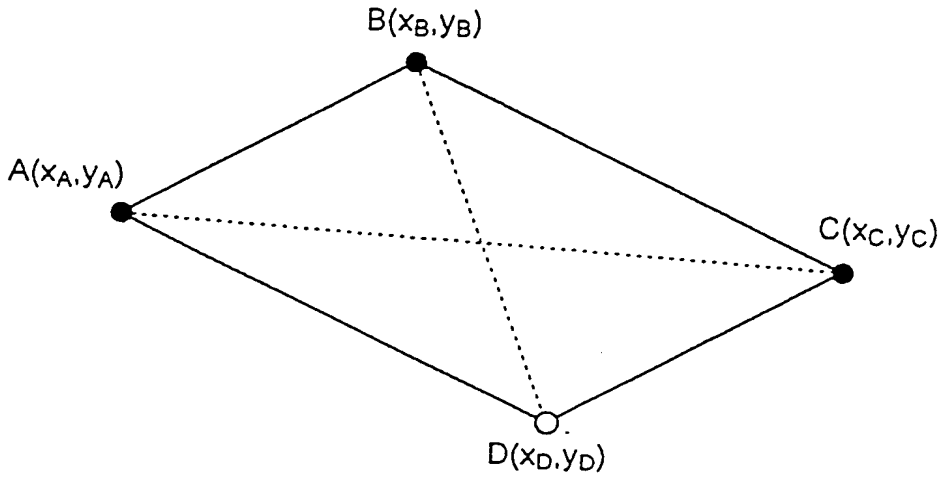
【図７】

[FIG. 7]


REPRESENTATIVE POINT LOCUS DATA
代表点軌跡データ
節点フレーム番号
多項式次数
多項式係数(0次)
多項式係数(1次)
多項式係数(K次)
節点フレーム番号
多項式次数
多項式係数(0次)
多項式係数(1次)
多項式係数(K'次)
1400
1401
1402
1403
KNOG FRAME NUMBER
ORDER OF POLYNOMINAL
COEFFICIENT OF POLYNOMINAL (0th-ORDER)
COEFFICIENT OF POLYNOMINAL (1th-ORDER)
COEFFICIENT OF POLYNOMINAL (Kth-ORDER)
KNOT FRAME NUMBER
ORDER OF POLYNOMINAL
COEFFICIENT OF POLYNOMINAL (0th-ORDER)
COEFFICIENT OF POLYNOMINAL (1th-ORDER)
COEFFICIENT OF POLYNOMINAL (K'th-ORDER)

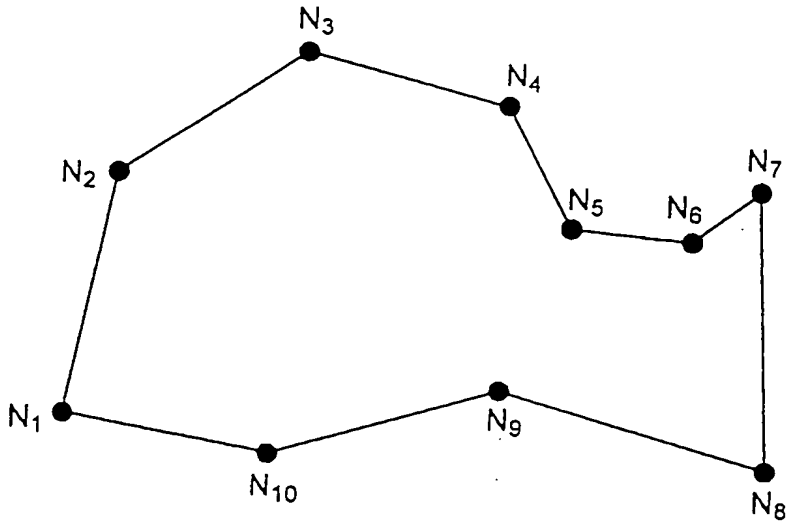
【図８】

[FIG. 8]



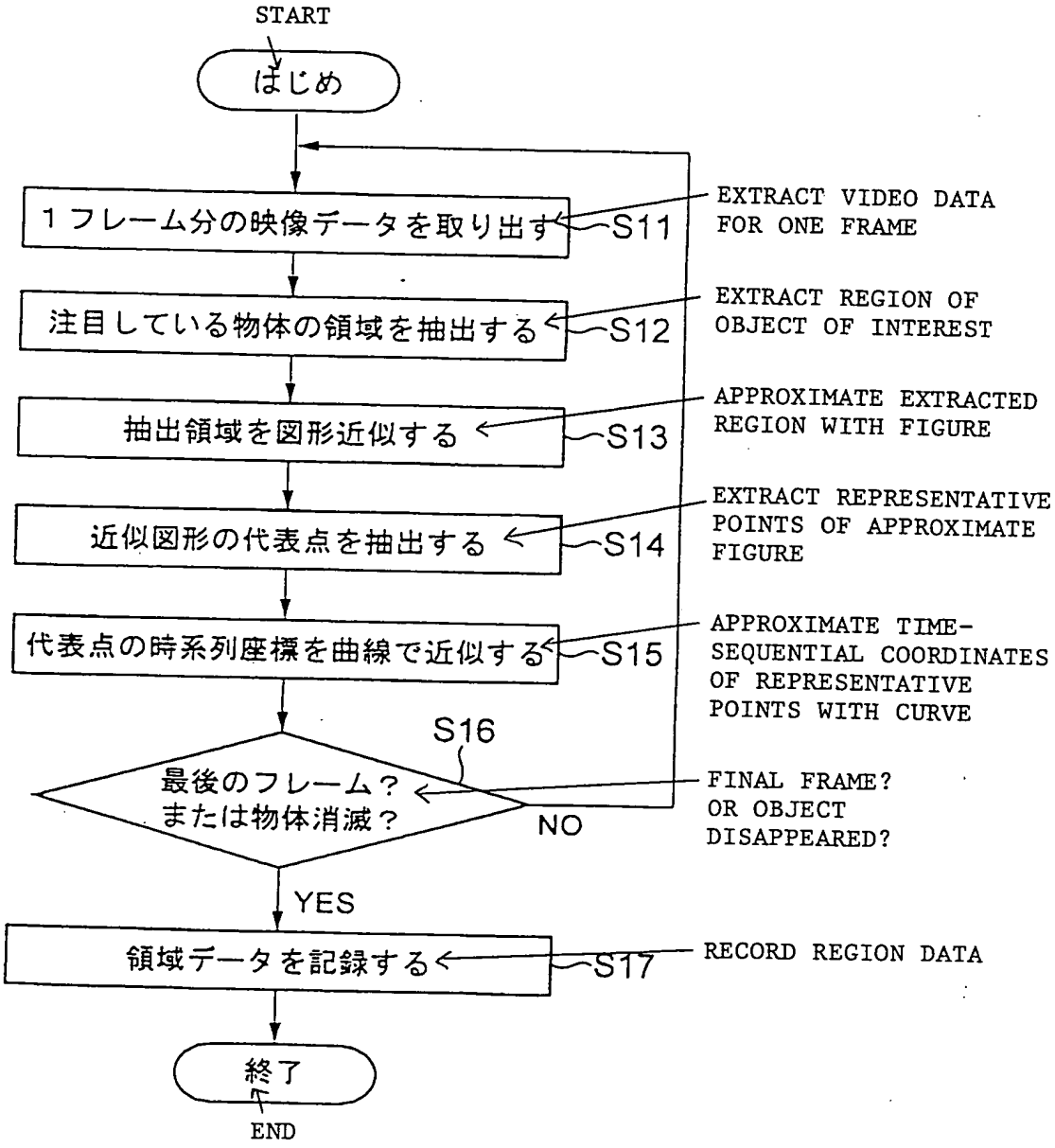
【図９】

[FIG. 9]



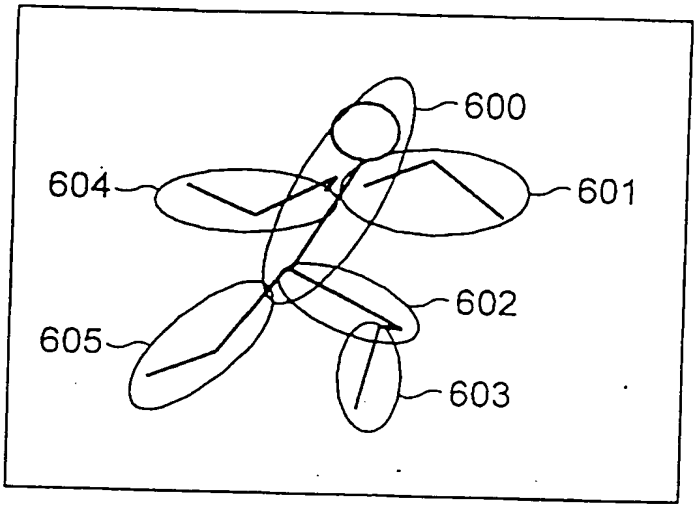
【図１０】

[FIG. 10]


START
はじめ
１フレーム分の映像データを取り出す
S11
EXTRACT VIDEO DATA FOR ONE FRAME
注目している物体の領域を抽出する
S12
EXTRACT REGION OF OBJECT OF INTEREST
抽出領域を図形近似する
S13
APPROXIMATE EXTRACTED REGION WITH FIGURE
近似図形の代表点を抽出する
S14
EXTRACT REPRESENTATIVE POINTS OF APPROXIMATE FIGURE
代表点の時系列座標を曲線で近似する
S15
APPROXIMATE TIME-SEQUENTIAL COORDINATES OF REPRESENTATIVE POINTS WITH CURVE
S16
最後のフレーム？
または物体消滅？
NO
FINAL FRAME? OR OBJECT DISAPPEARED?
YES
領域データを記録する
S17
RECORD REGION DATA
終了
END

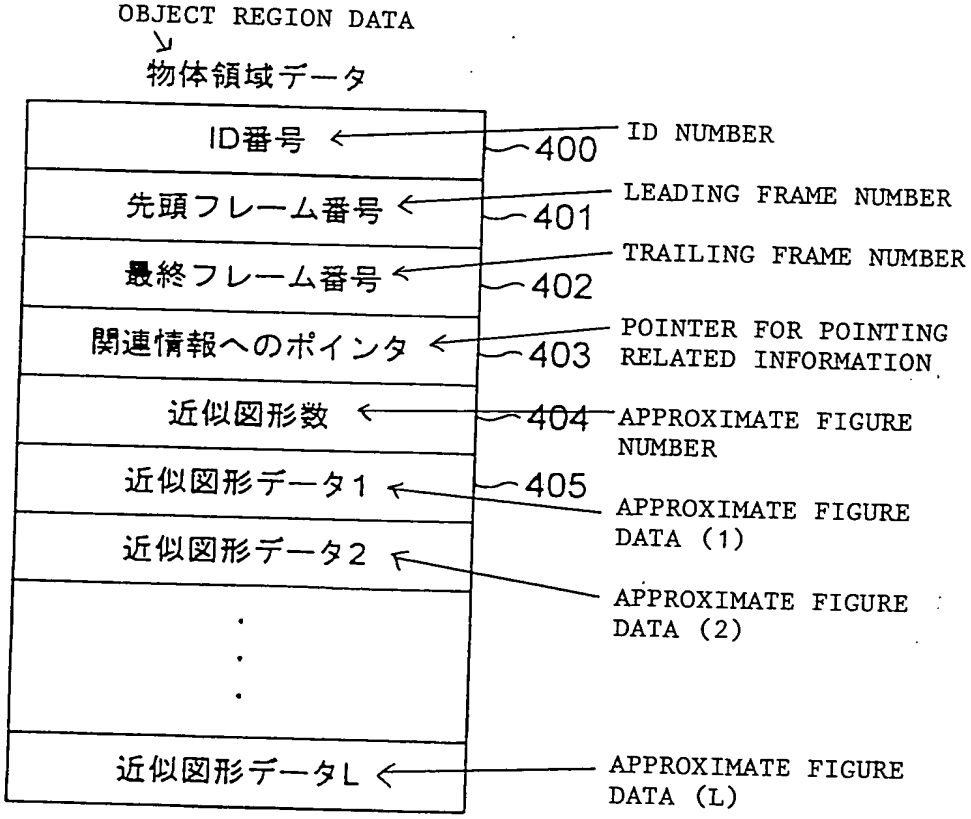
【図１１】

[FIG. 11]



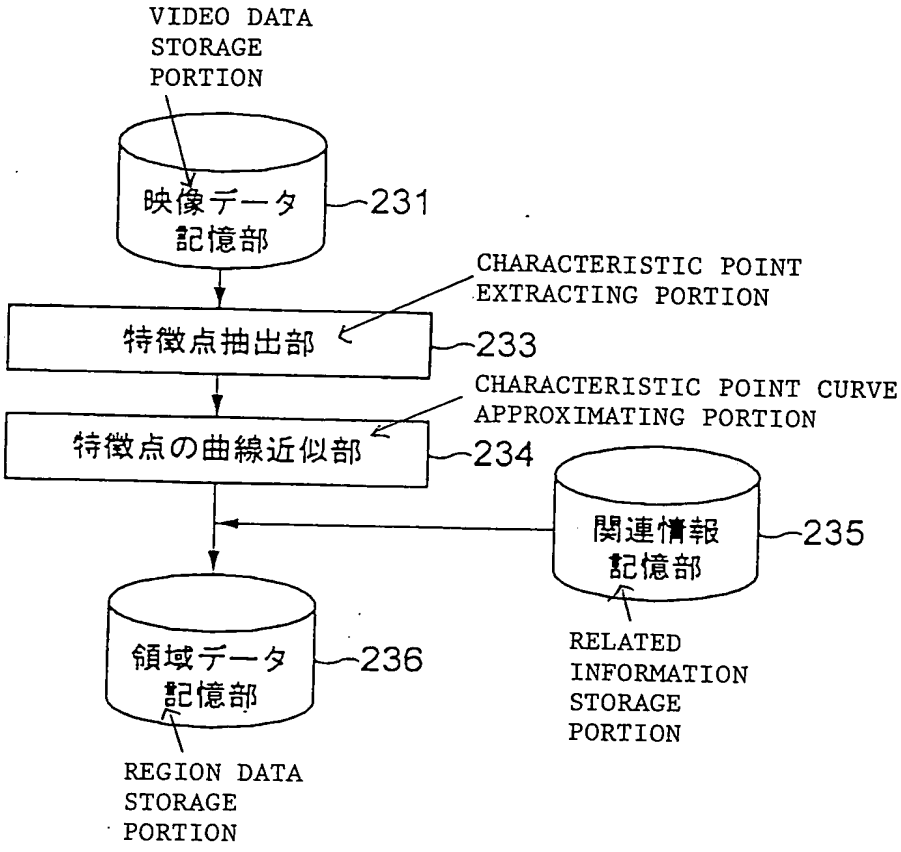
【図１２】

[FIG. 12]



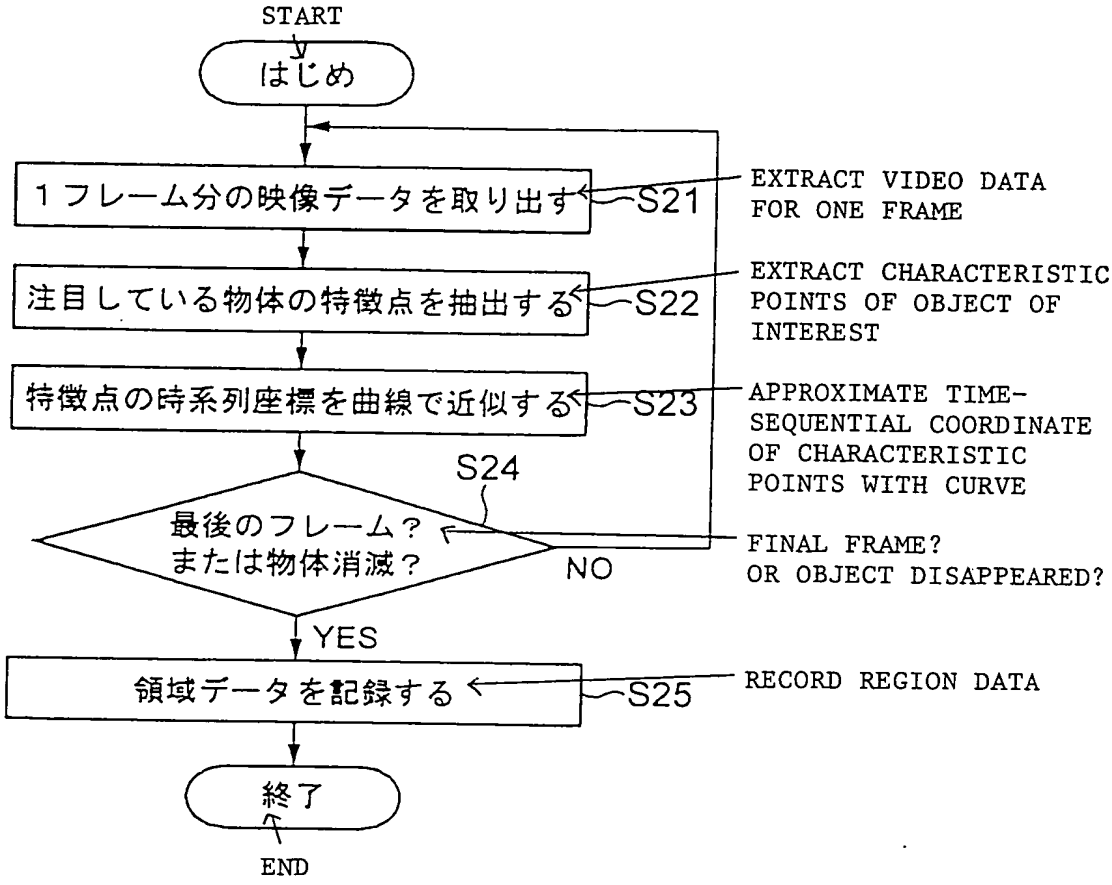
【図１３】

FIG. 13


VIDEO DATA
STORAGE
PORTION
映像データ
記憶部
231
CHARACTERISTIC POINT
EXTRACTING PORTION
特徴点抽出部
233
CHARACTERISTIC POINT CURVE
APPROXIMATING PORTION
特徴点の曲線近似部
234
関連情報
記憶部
235
RELATED
INFORMATION
STORAGE
PORTION
領域データ
記憶部
236
REGION DATA
STORAGE
PORTION

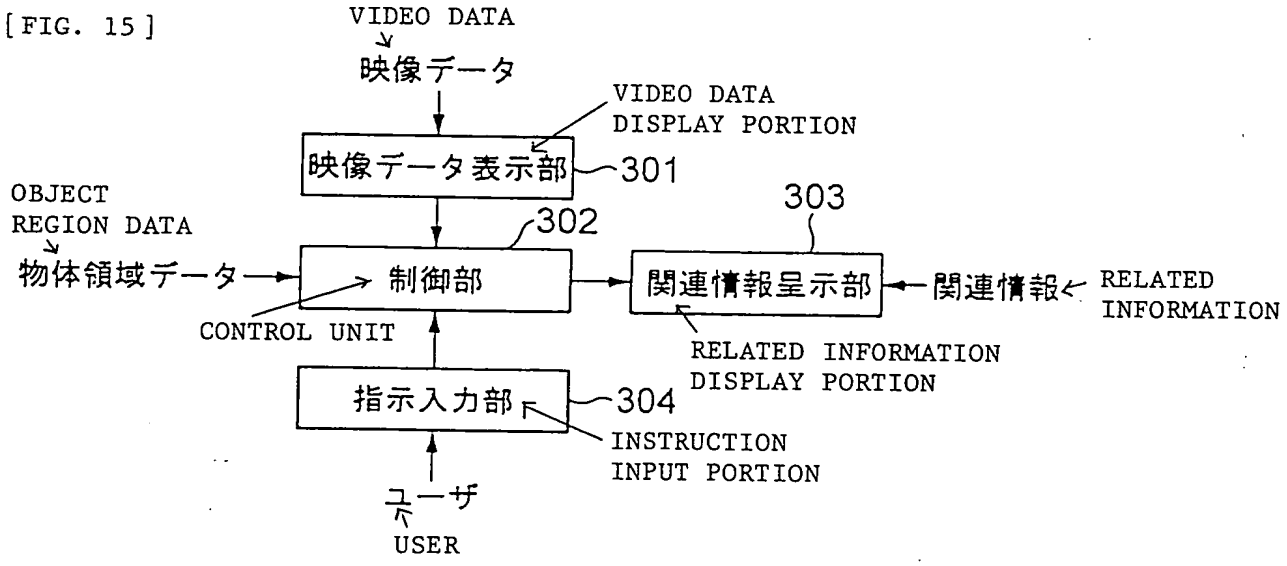
【図１４】

[FIG. 14]



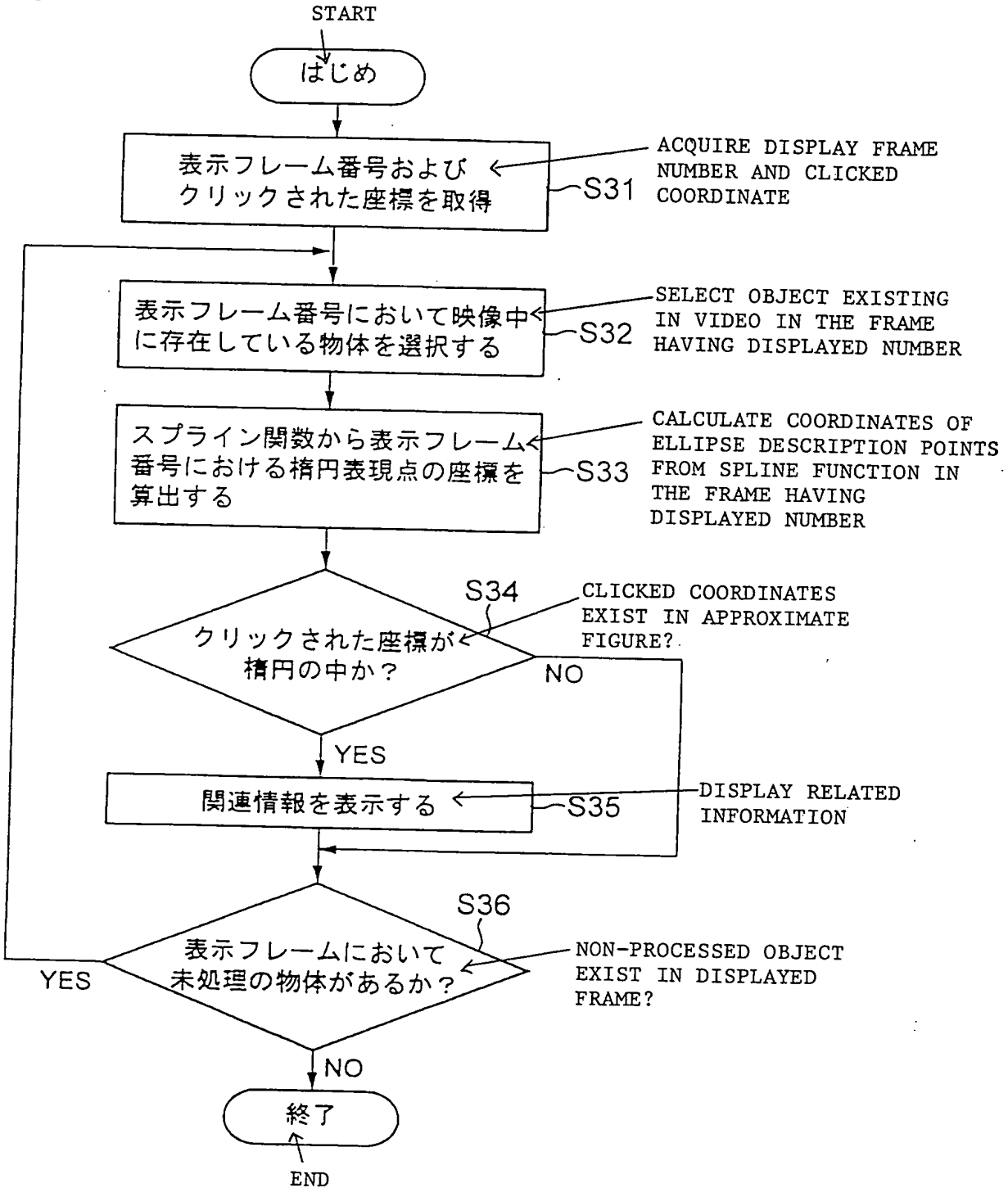
【図１５】

[FIG. 15]



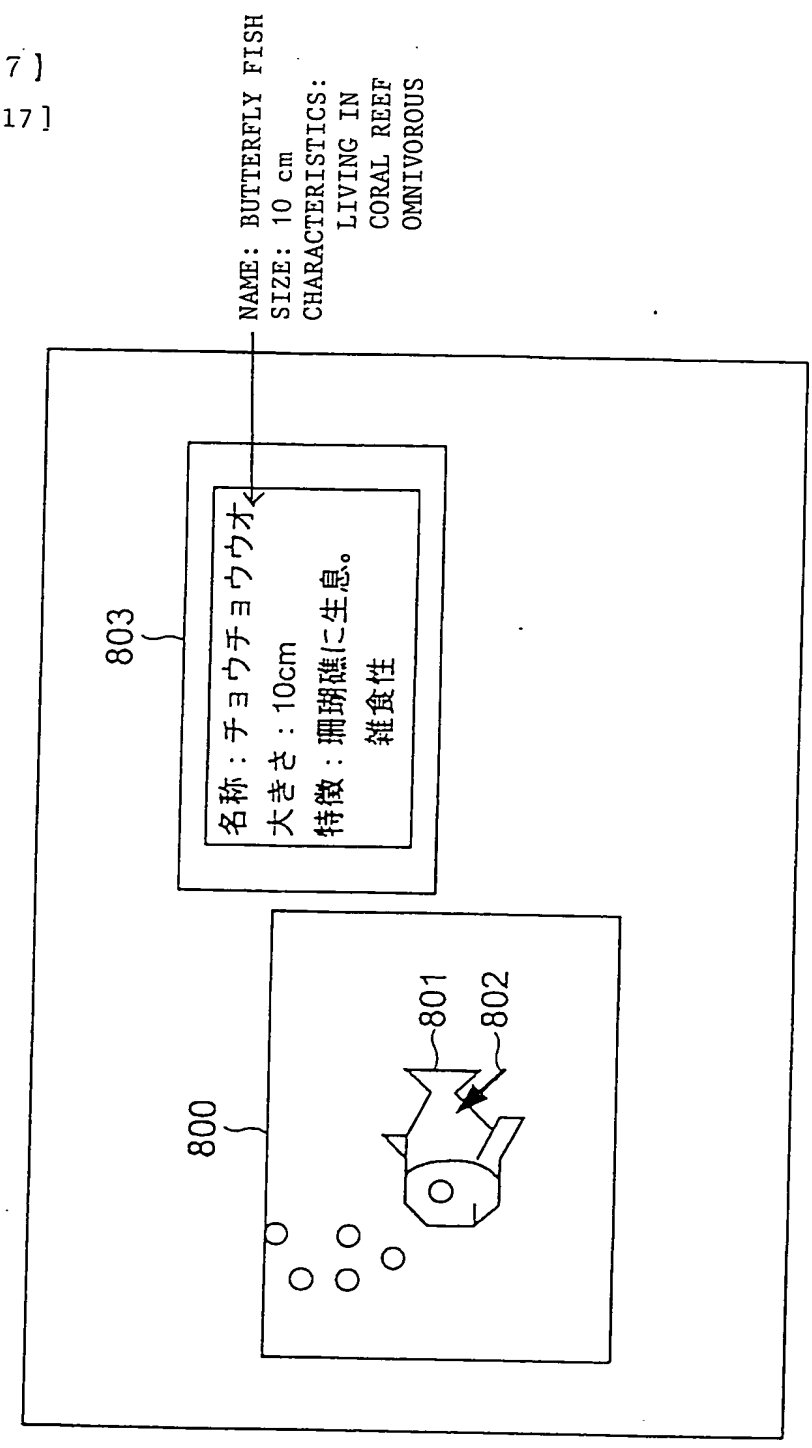
【図１６】

[FIG. 16]


START
はじめ
表示フレーム番号および
クリックされた座標を取得
S31
ACQUIRE DISPLAY FRAME NUMBER AND CLICKED COORDINATE
表示フレーム番号において映像中
に存在している物体を選択する
S32
SELECT OBJECT EXISTING IN VIDEO IN THE FRAME HAVING DISPLAYED NUMBER
スプライン関数から表示フレーム
番号における楕円表現点の座標を
算出する
S33
CALCULATE COORDINATES OF ELLIPSE DESCRIPTION POINTS FROM SPLINE FUNCTION IN THE FRAME HAVING DISPLAYED NUMBER
S34
クリックされた座標が
楕円の中か？
CLICKED COORDINATES EXIST IN APPROXIMATE FIGURE?
NO
YES
関連情報を表示する
S35
DISPLAY RELATED INFORMATION
S36
表示フレームにおいて
未処理の物体があるか？
NON-PROCESSED OBJECT EXIST IN DISPLAYED FRAME?
YES
NO
終了
END

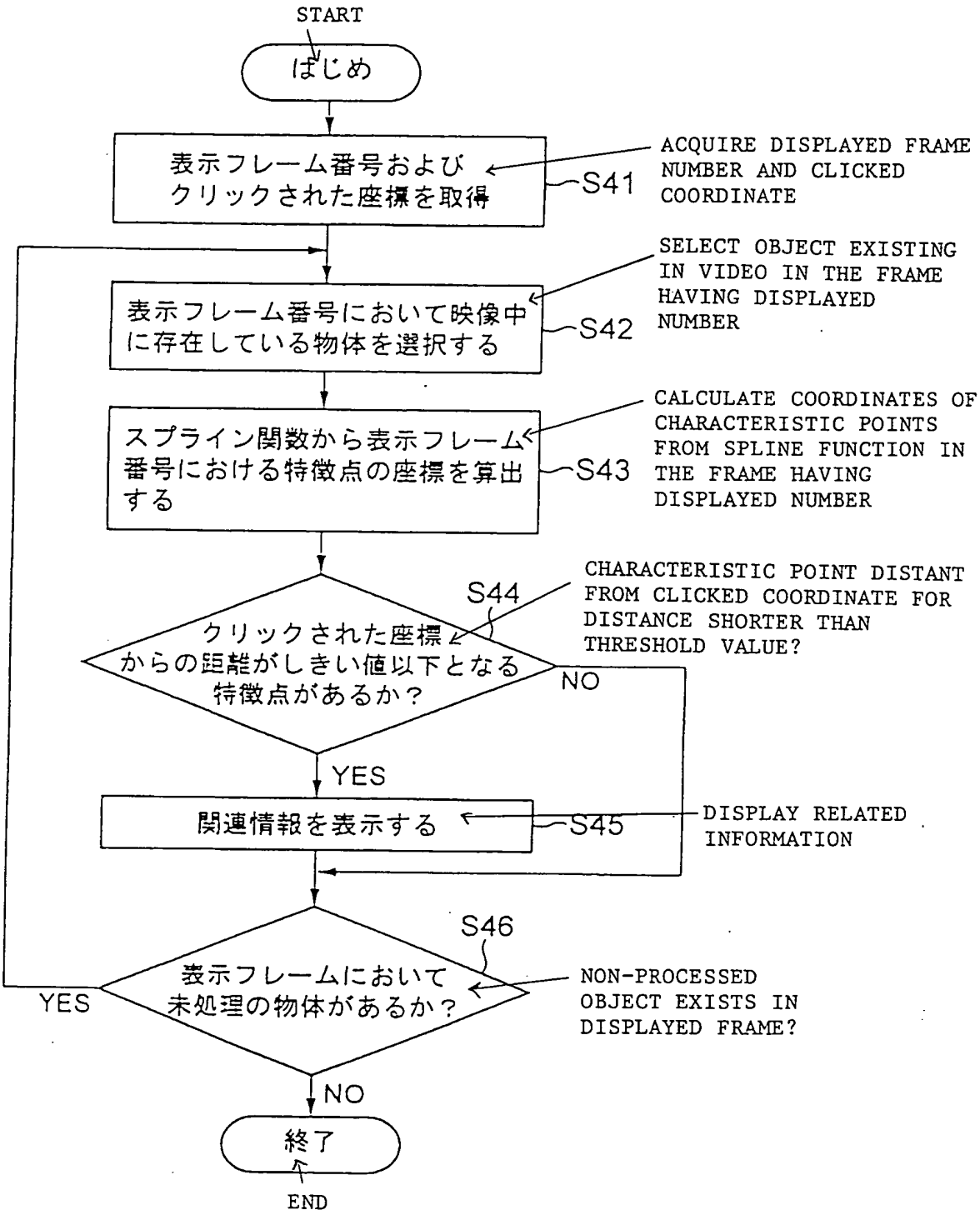
【図１７】

[FIG. 17]


NAME: BUTTERFLY FISH
SIZE: 10 cm
CHARACTERISTICS:
LIVING IN
CORAL REEF
OMNIVOROUS
803
名称：チョウチョウウオ
大きさ：10cm
特徴：珊瑚礁に生息。
雑食性
800
801
802

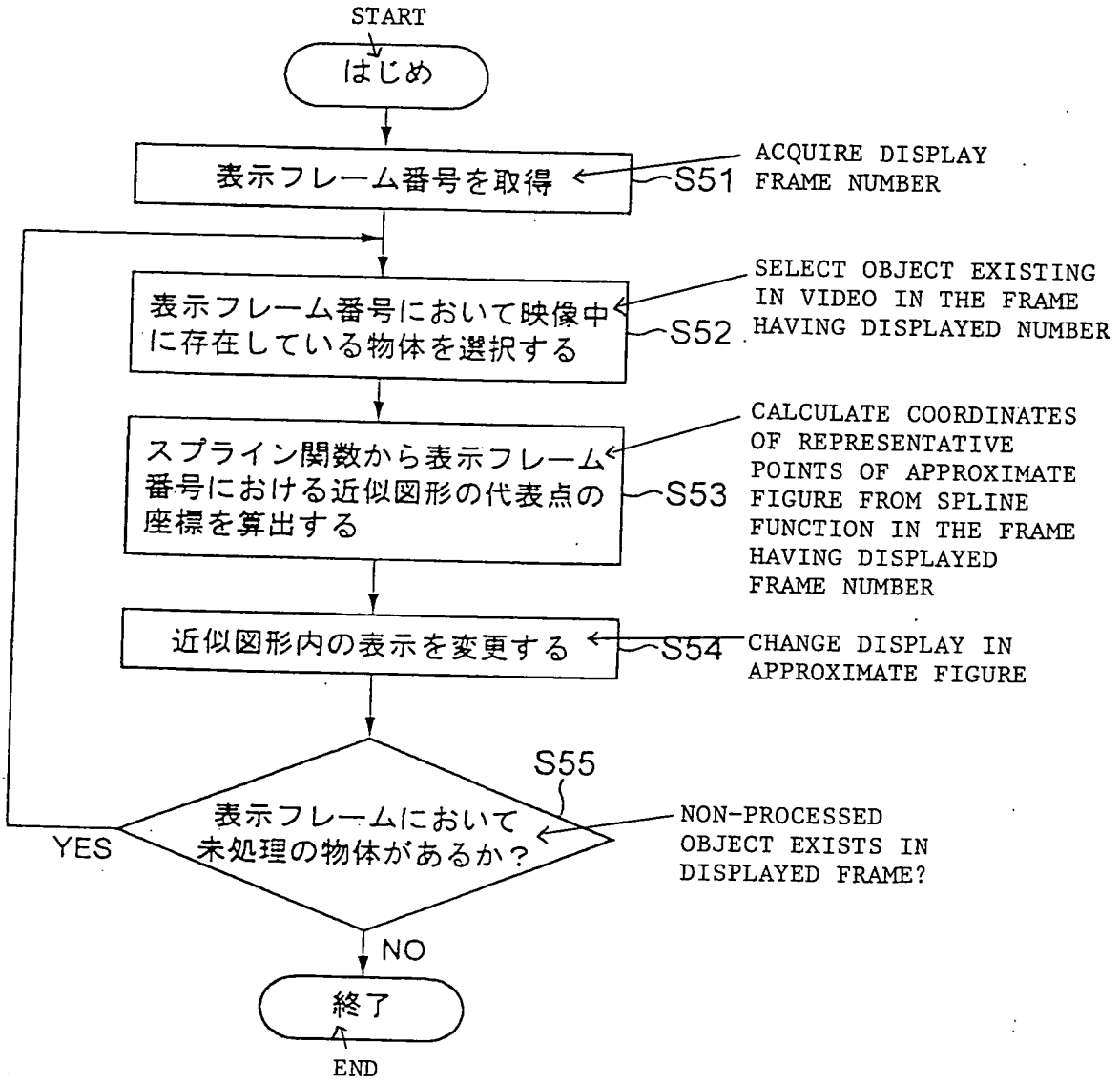
【図１８】

[FIG. 18]


START
はじめ
表示フレーム番号および
クリックされた座標を取得
S41
ACQUIRE DISPLAYED FRAME NUMBER AND CLICKED COORDINATE
表示フレーム番号において映像中
に存在している物体を選択する
S42
SELECT OBJECT EXISTING IN VIDEO IN THE FRAME HAVING DISPLAYED NUMBER
スプライン関数から表示フレーム
番号における特徴点の座標を算出
する
S43
CALCULATE COORDINATES OF CHARACTERISTIC POINTS FROM SPLINE FUNCTION IN THE FRAME HAVING DISPLAYED NUMBER
S44
クリックされた座標
からの距離がしきい値以下となる
特徴点があるか？
CHARACTERISTIC POINT DISTANT FROM CLICKED COORDINATE FOR DISTANCE SHORTER THAN THRESHOLD VALUE?
NO
YES
関連情報を表示する
S45
DISPLAY RELATED INFORMATION
S46
表示フレームにおいて
未処理の物体があるか？
NON-PROCESSED OBJECT EXISTS IN DISPLAYED FRAME?
YES
NO
終了
END

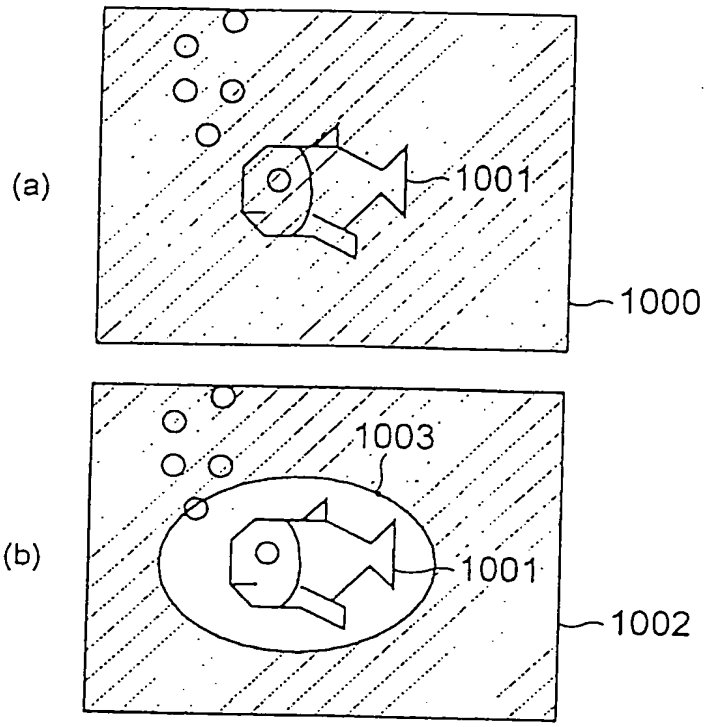
【図１９】

[FIG. 19]


START
はじめ
表示フレーム番号を取得
S51
ACQUIRE DISPLAY FRAME NUMBER
表示フレーム番号において映像中に存在している物体を選択する
S52
SELECT OBJECT EXISTING IN VIDEO IN THE FRAME HAVING DISPLAYED NUMBER
スプライン関数から表示フレーム番号における近似図形の代表点の座標を算出する
S53
CALCULATE COORDINATES OF REPRESENTATIVE POINTS OF APPROXIMATE FIGURE FROM SPLINE FUNCTION IN THE FRAME HAVING DISPLAYED FRAME NUMBER
近似図形内の表示を変更する
S54
CHANGE DISPLAY IN APPROXIMATE FIGURE
S55
表示フレームにおいて未処理の物体があるか？
NON-PROCESSED OBJECT EXISTS IN DISPLAYED FRAME?
YES
NO
終了
END

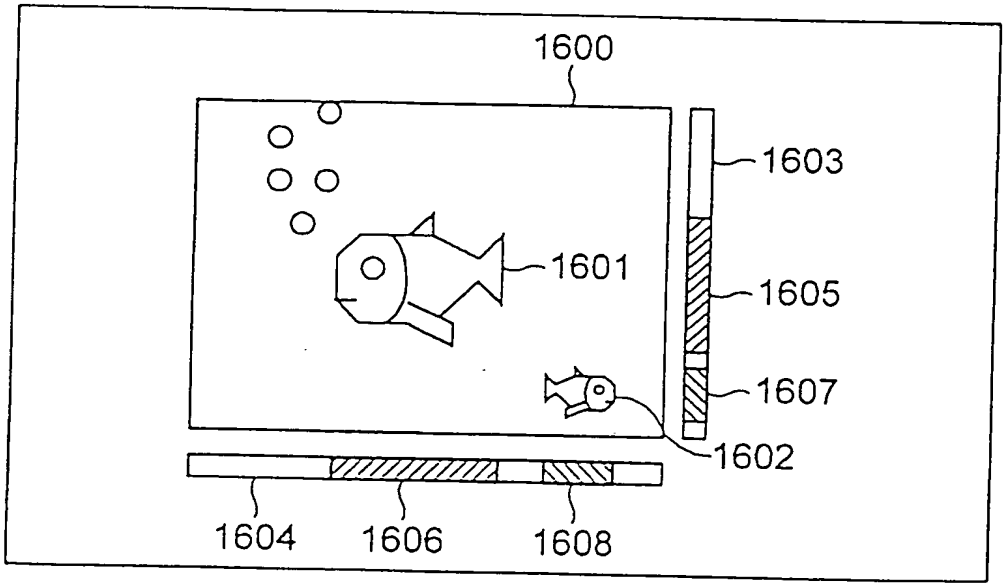
[図２０]

[FIG. 20]



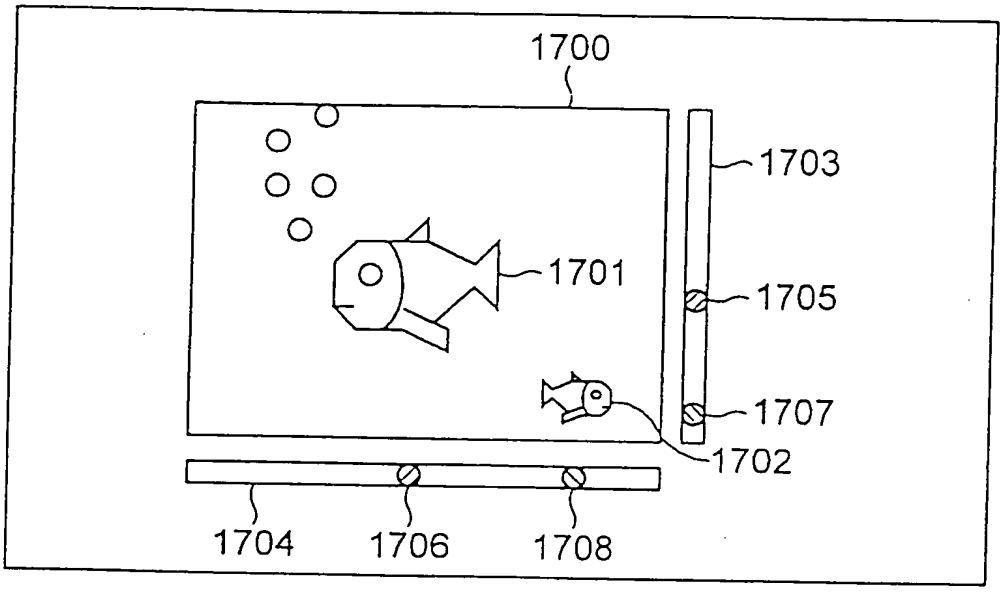
[FIG. 21]

[図２１]



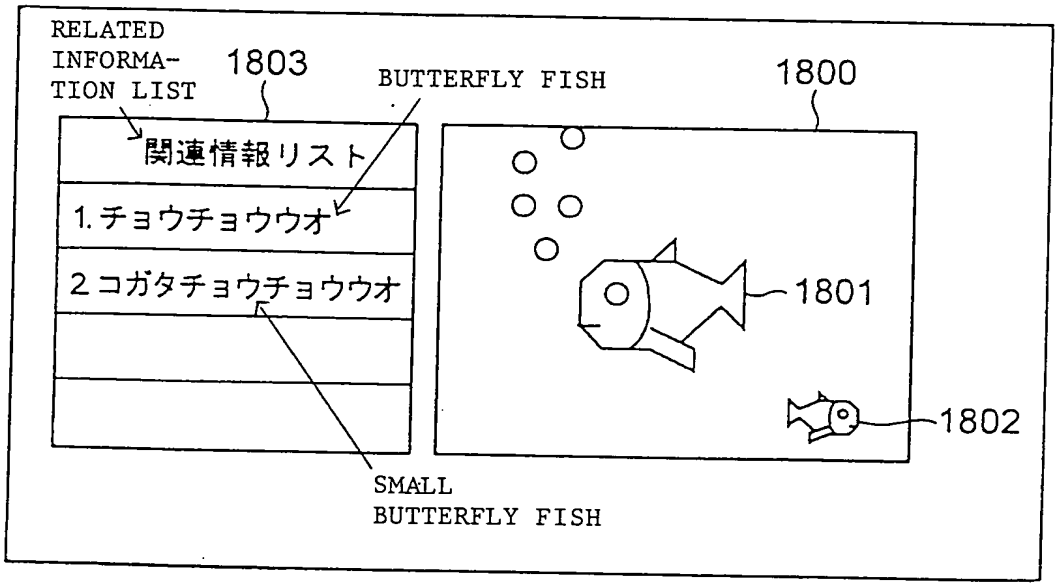
【図２２】

[FIG. 22]



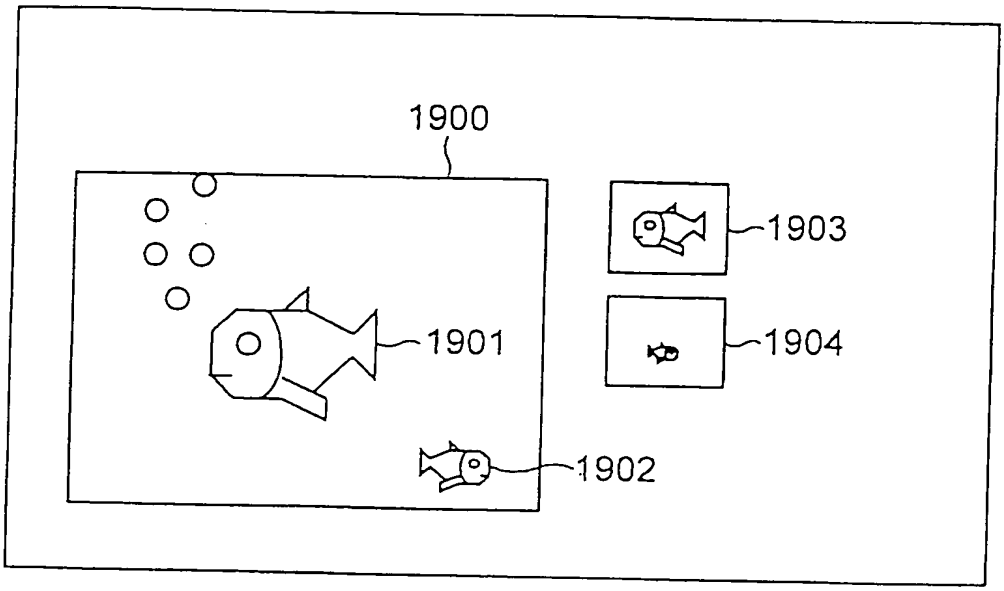
【図２３】

[FIG. 23]



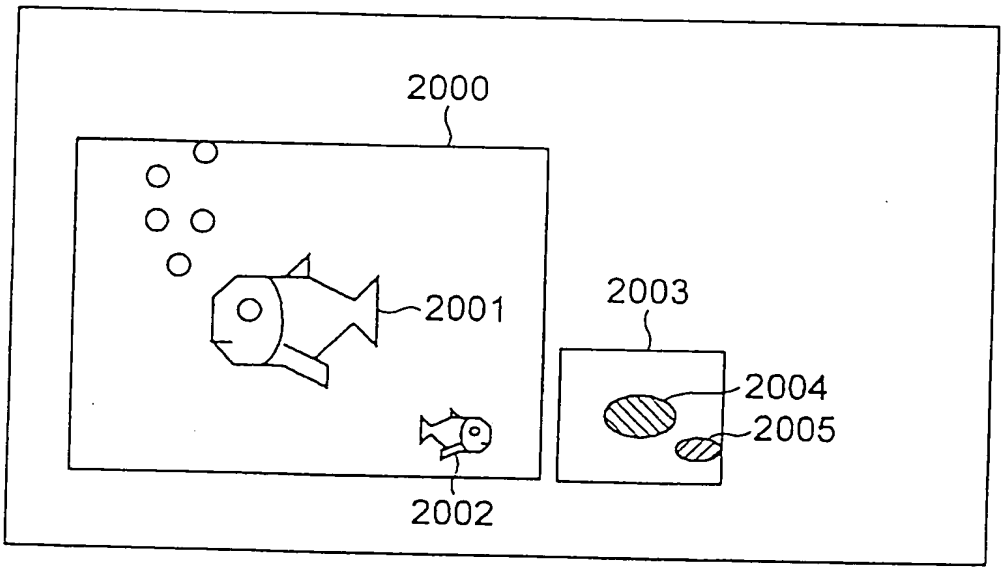
【図２４】

[FIG. 24]



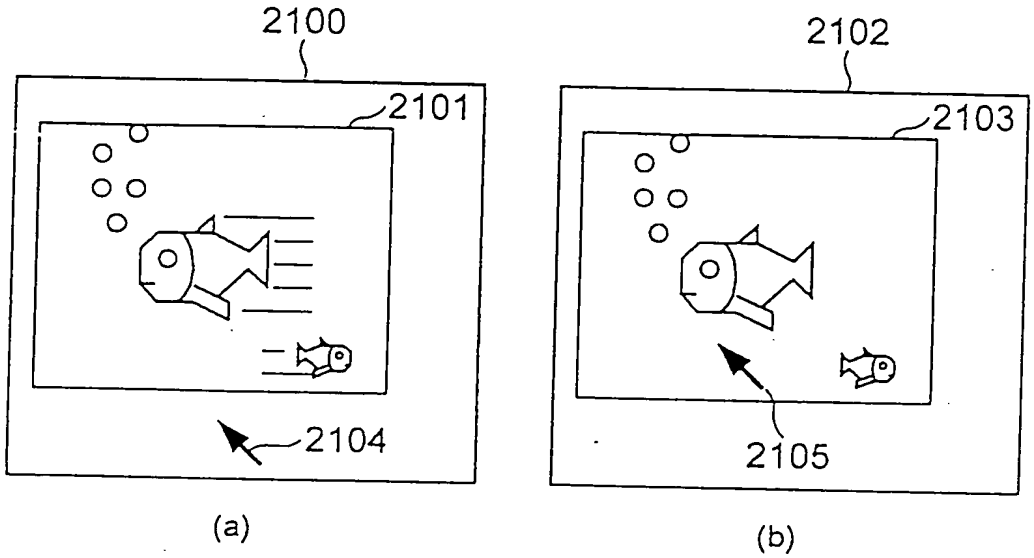
【図２５】

[FIG. 25]



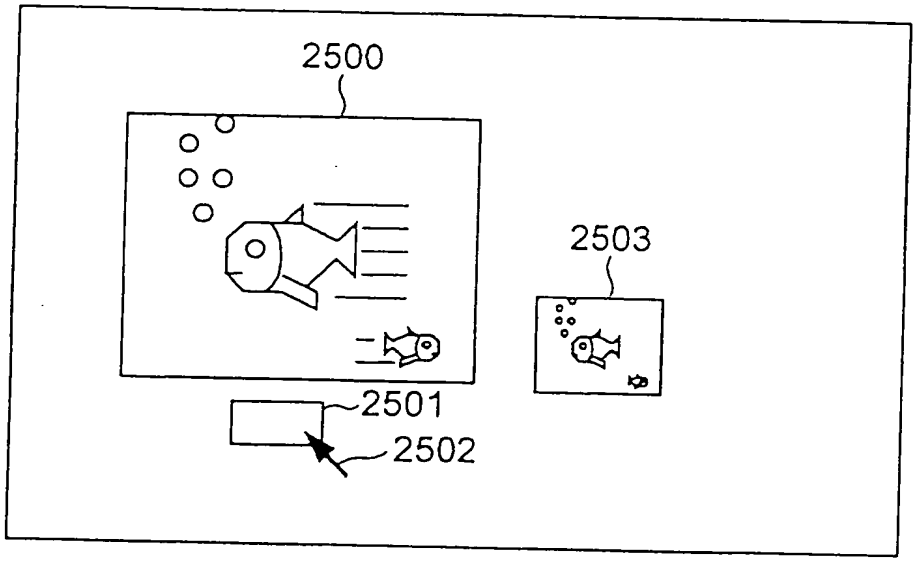
【図２６】

[FIG. 26]



【図２７】

[FIG. 27]



[Document] ABSTRACT

[Abstract]

[Object] It is an object of the present invention to provide a method of describing object region data which is capable of describing a desired object region in a video by using a small quantity of data and facilitating generation of data and handling of the same.

[Means for Achieving the Object] A method of describing object region data such that information about an arbitrary object region in a video is described over a plurality of continuous frames, the method comprising: identifying a desired object region 201 in a video according to at least either of a figure 202 approximated to the object region or a characteristic point of the object region; approximating a trajectory obtained by arranging positions of representative points 203 of the approximate figure 202 or the characteristic points of the object region in a direction in which frames 200 proceed with a predetermined function 204; and describing information about the object region by using the parameter 205 of the function.

[Elected Figure] FIG. 2